Consejos para diseño de red

Area de Ingeniería Telemática
http://www.tlm.unavarra.es

Redes de Banda Ancha
5º Ingeniería de Telecomunicación

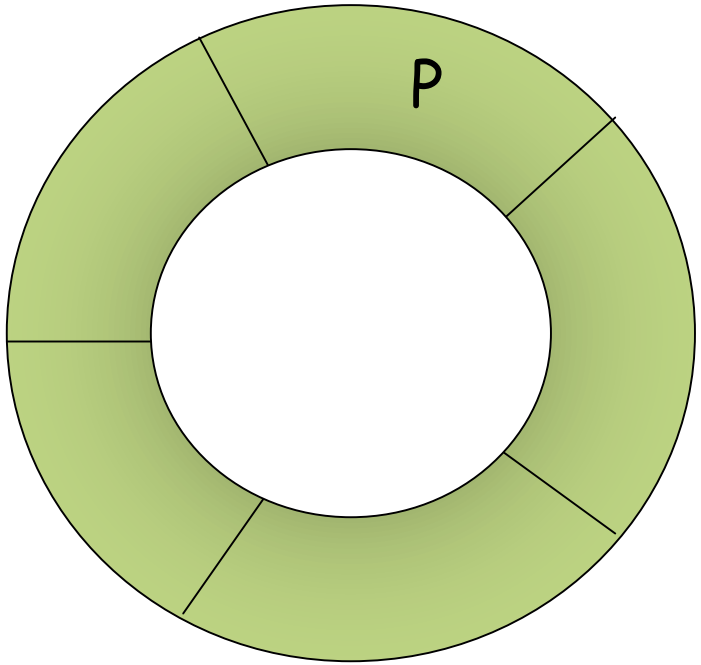
Requisitos

- Que **funcione**
- **Escalabilidad**: que soporte aumentar de tamaño sin cambios importantes en el diseño
- **Adaptabilidad**: No incluya elementos que impidan emplear futuras tecnologías
- Facilidad de **administración**

Fases de diseño

Planificación

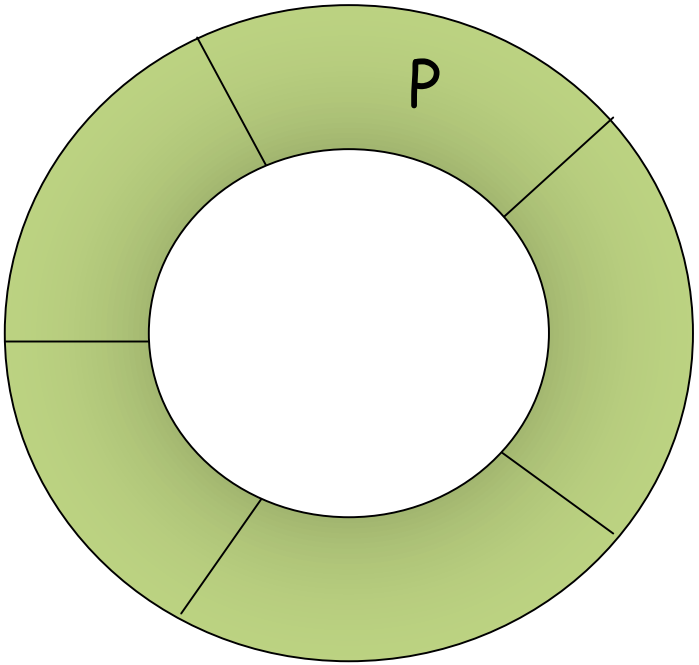
- Idenficación de requisitos
  - Aplicaciones y protocolos
  - Conexión a Internet
  - Direccionamiento (público/privado, IPv4/v6)
  - Redundancia
  - Wireless
  - QoS
  - …



Fases de diseño

Planificación

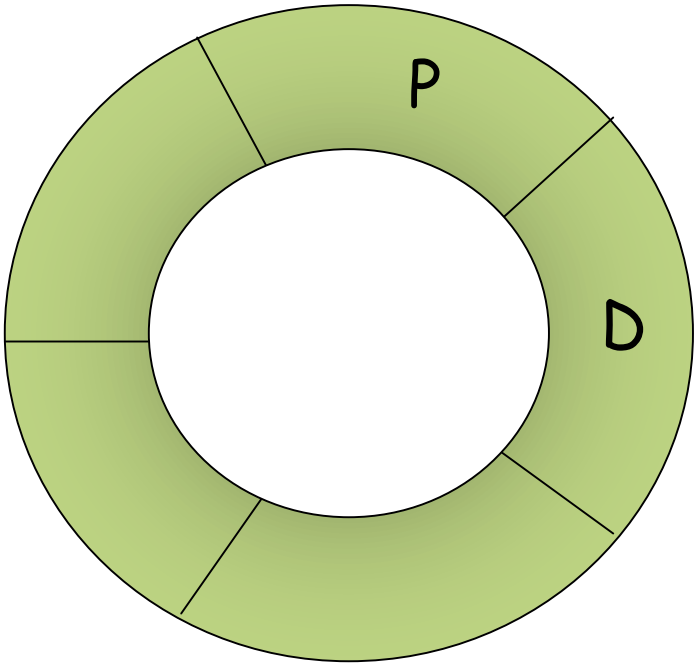
- Estudio del estado actual de la red
  - Cableado
  - Equipamiento que debe ser soportado
  - Procedimientos de administración
  - Topología
  - Utilización
  - …



Fases de diseño

Diseño

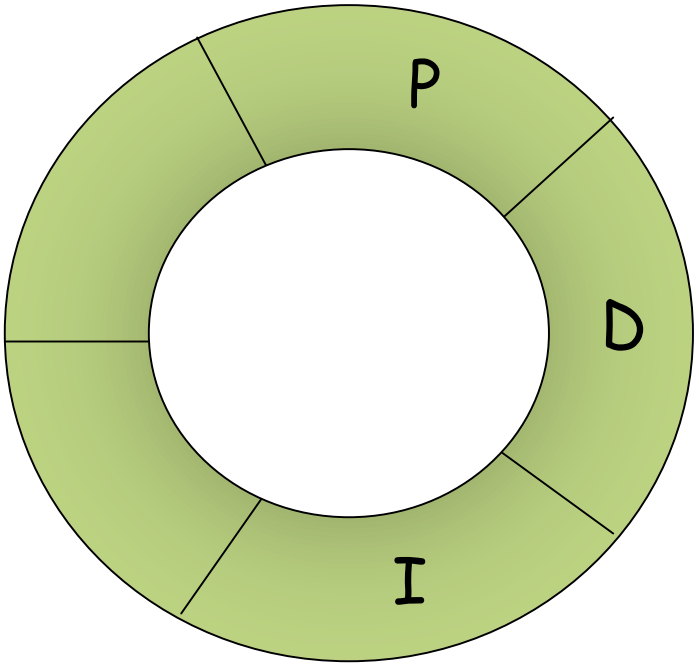
- Diseño de acuerdo con los requisitos y el estado de la red
- Consultado el propietario



Fases de diseño

Implementación

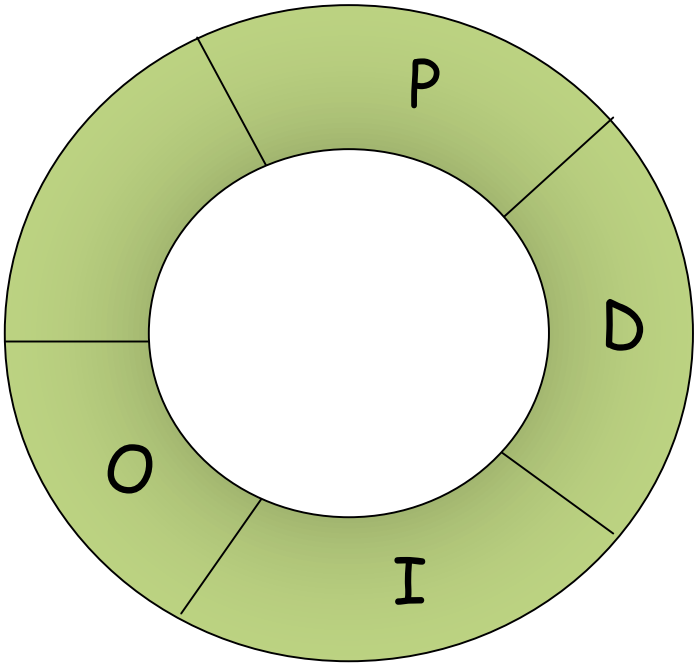
- Creación de acuerdo con el diseño
- Posible prototipo o red piloto



Fases de diseño

Operación

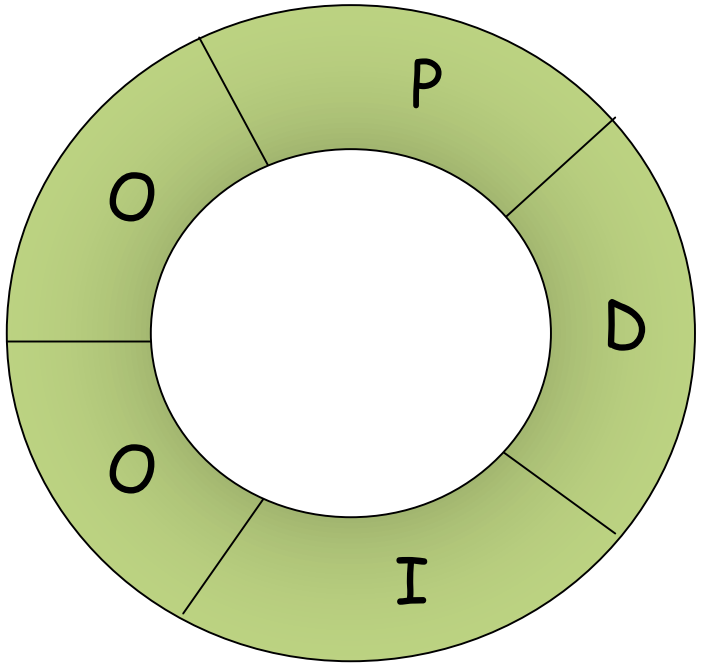
- Operación y monitorización de la red
- Comprobación final del diseño



Fases de diseño

Optimización

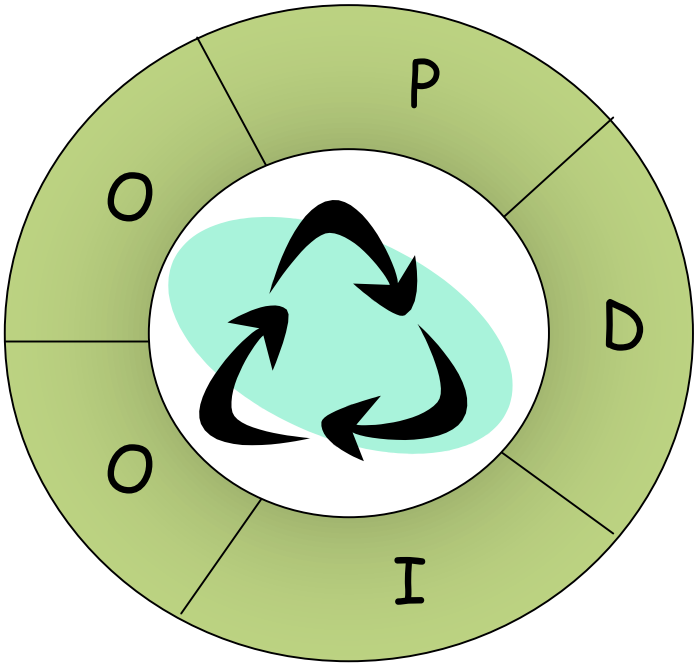
- Detección y corrección de problemas
- Puede requerir un rediseño



Fases de diseño

Retirada

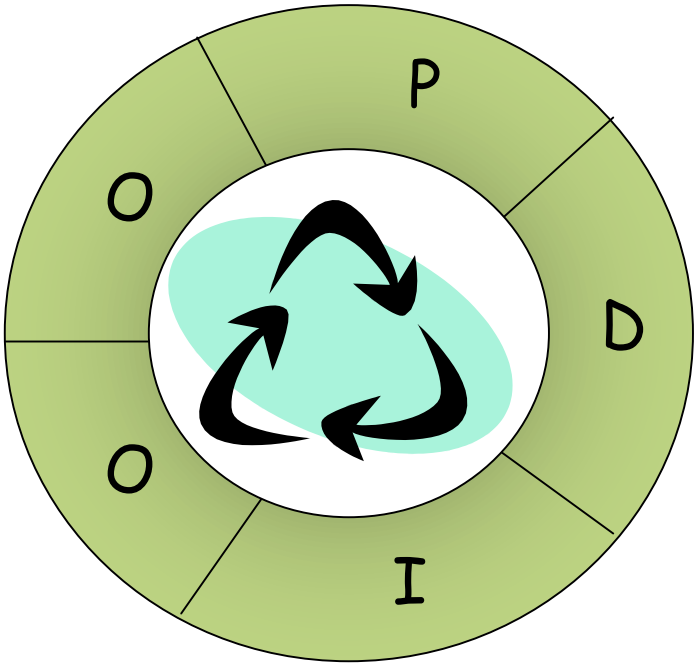
- Sustitución de equipamiento obsoleto



Fases de diseño

Documentación

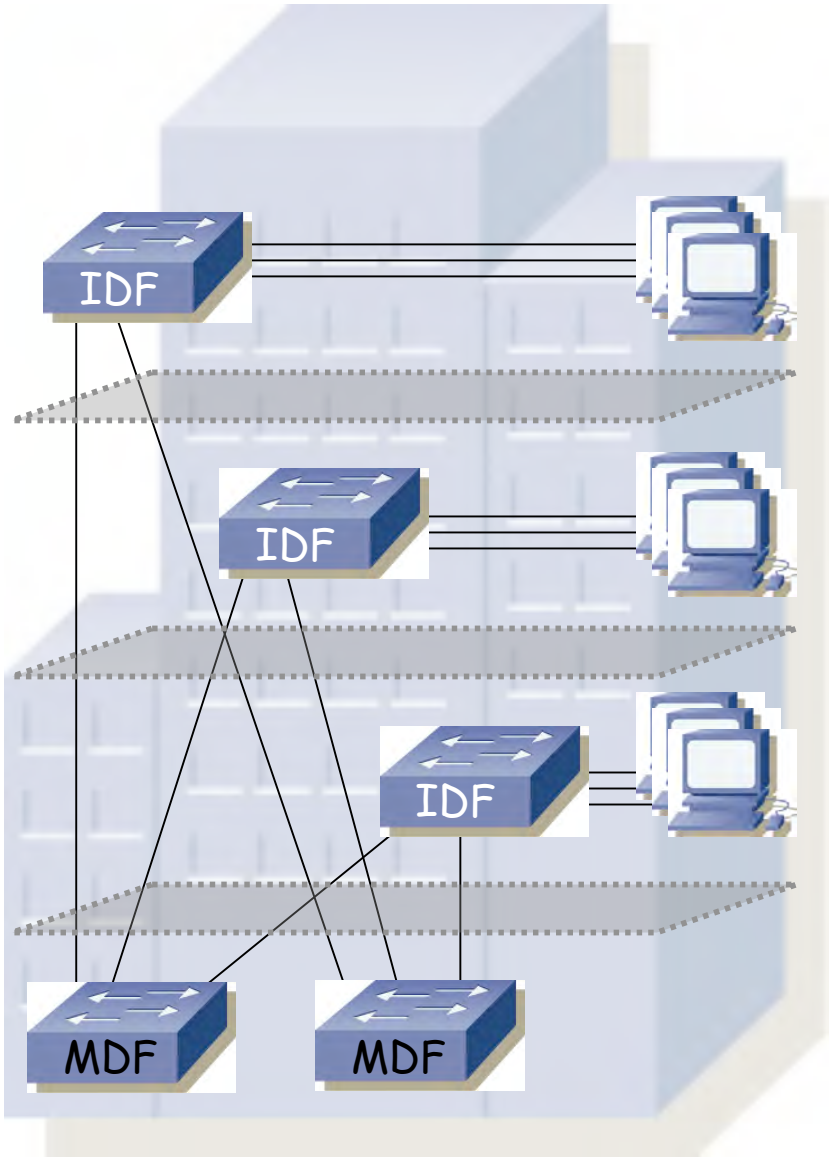
- Requerimientos
- Estado de la red anterior
- Justificación de la solución final
- Diseño final
- Resultados de pruebas prototipo
- Planificación de la implementación
- …



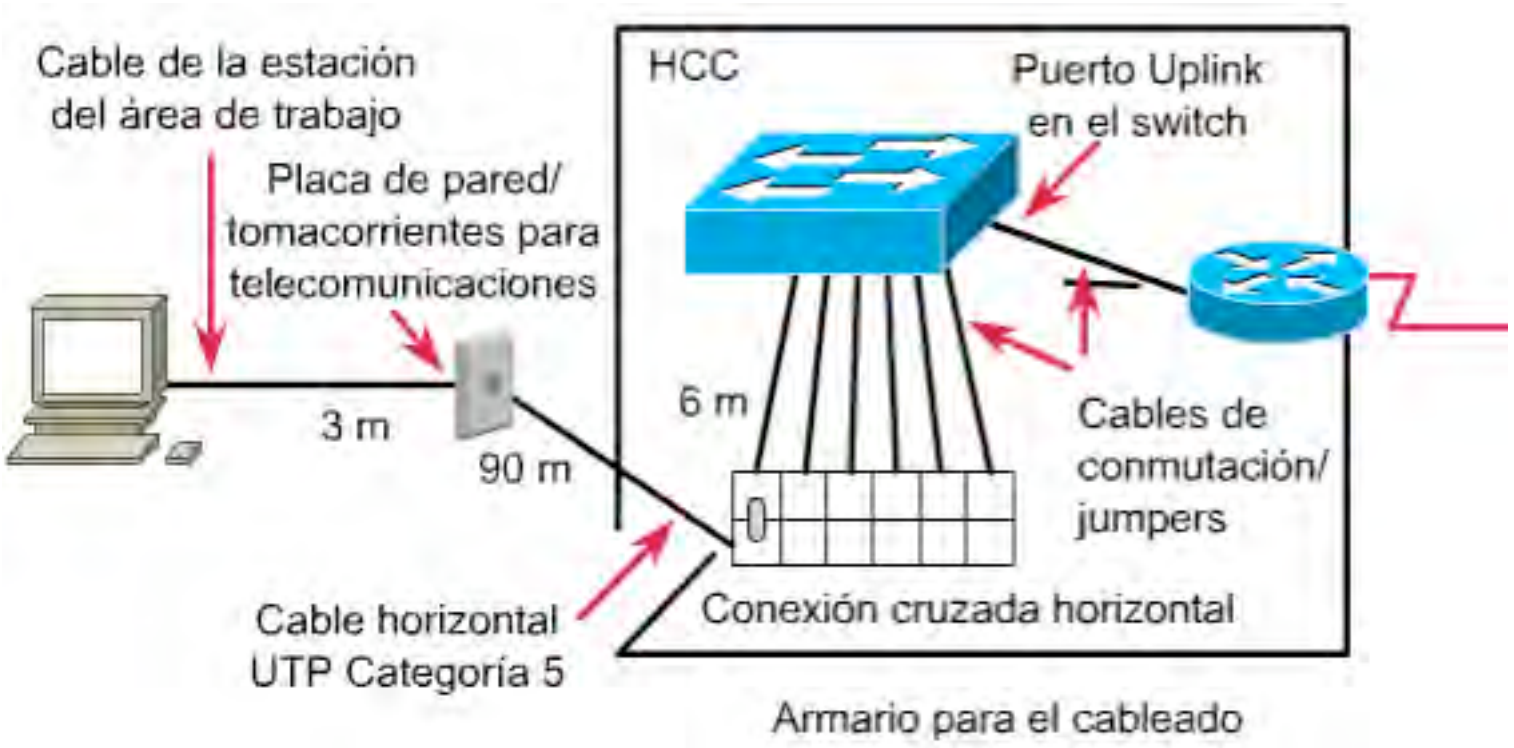
Terminología para 2 capas

IDF

- *Intermediate Distribution Frame*
- Cableado horizontal
- Conecta los hosts a la red
- Típicamente cableado UTP en estrella al armario de cableado
- Alta densidad de puertos
- Redundancia hacia el MDF
- Gestión escalable



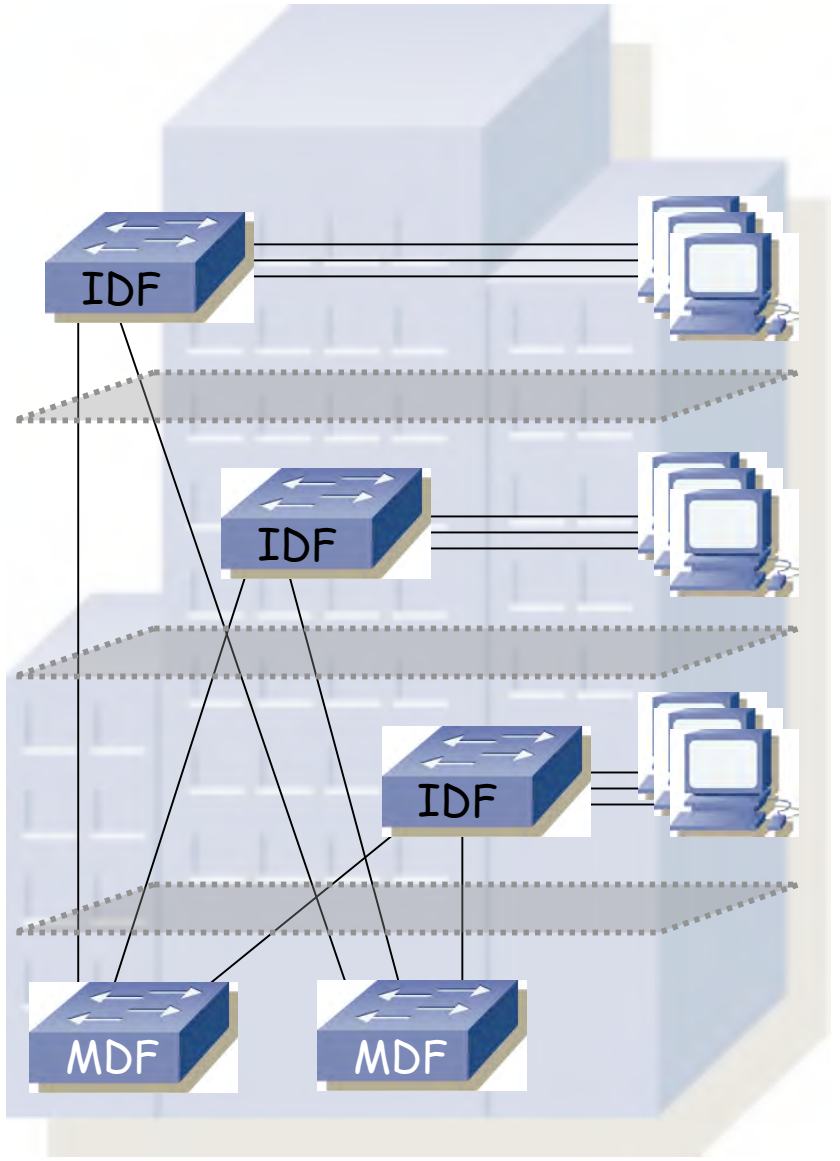
Terminología para 2 capas



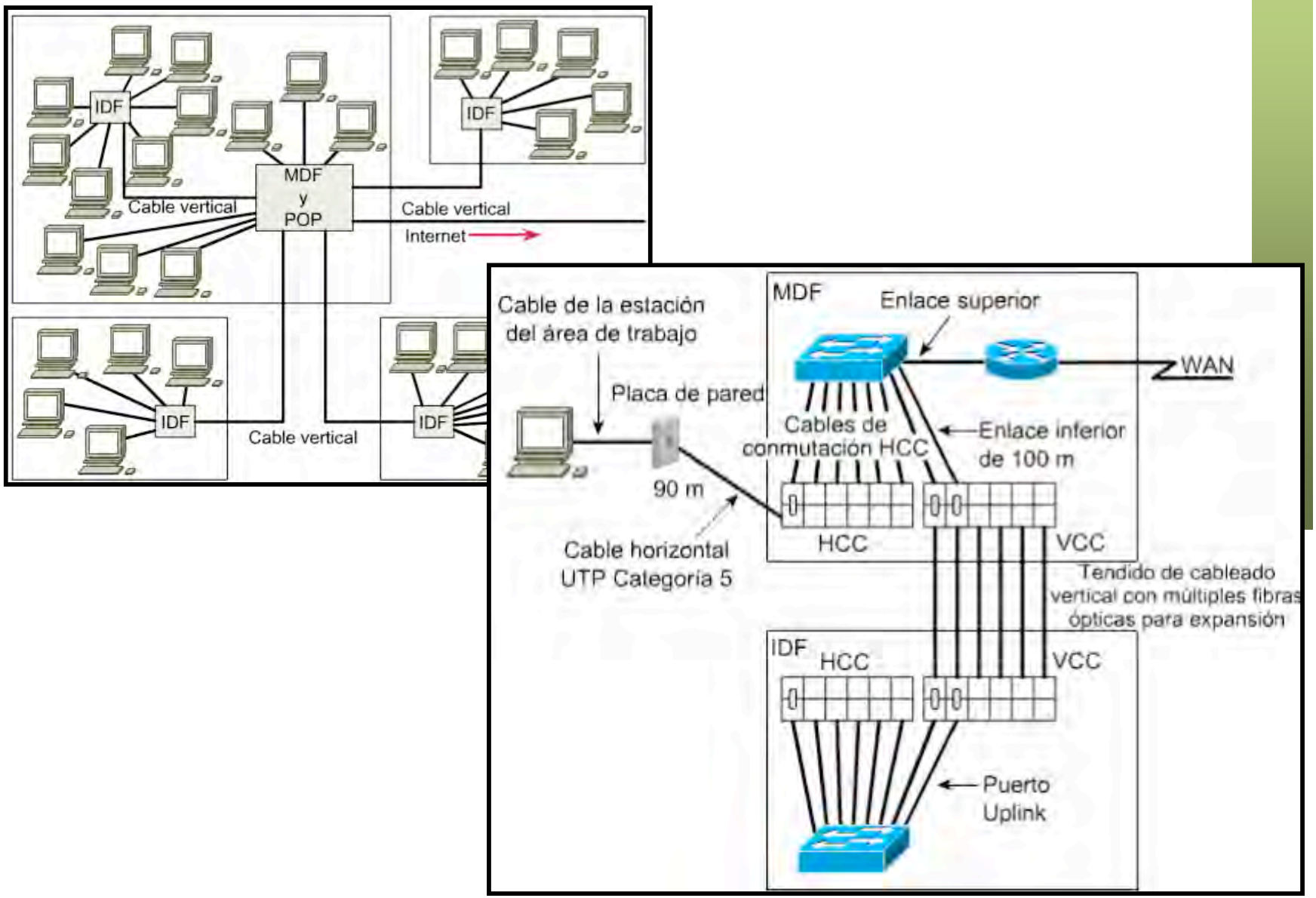
Terminología para 2 capas

MDF

- *Main Distribution Frame*
- Dispositivos del IDF en estrella respecto al MDF
- Redundancia en el MDF
- Mayores requisitos de throughput y disponibilidad

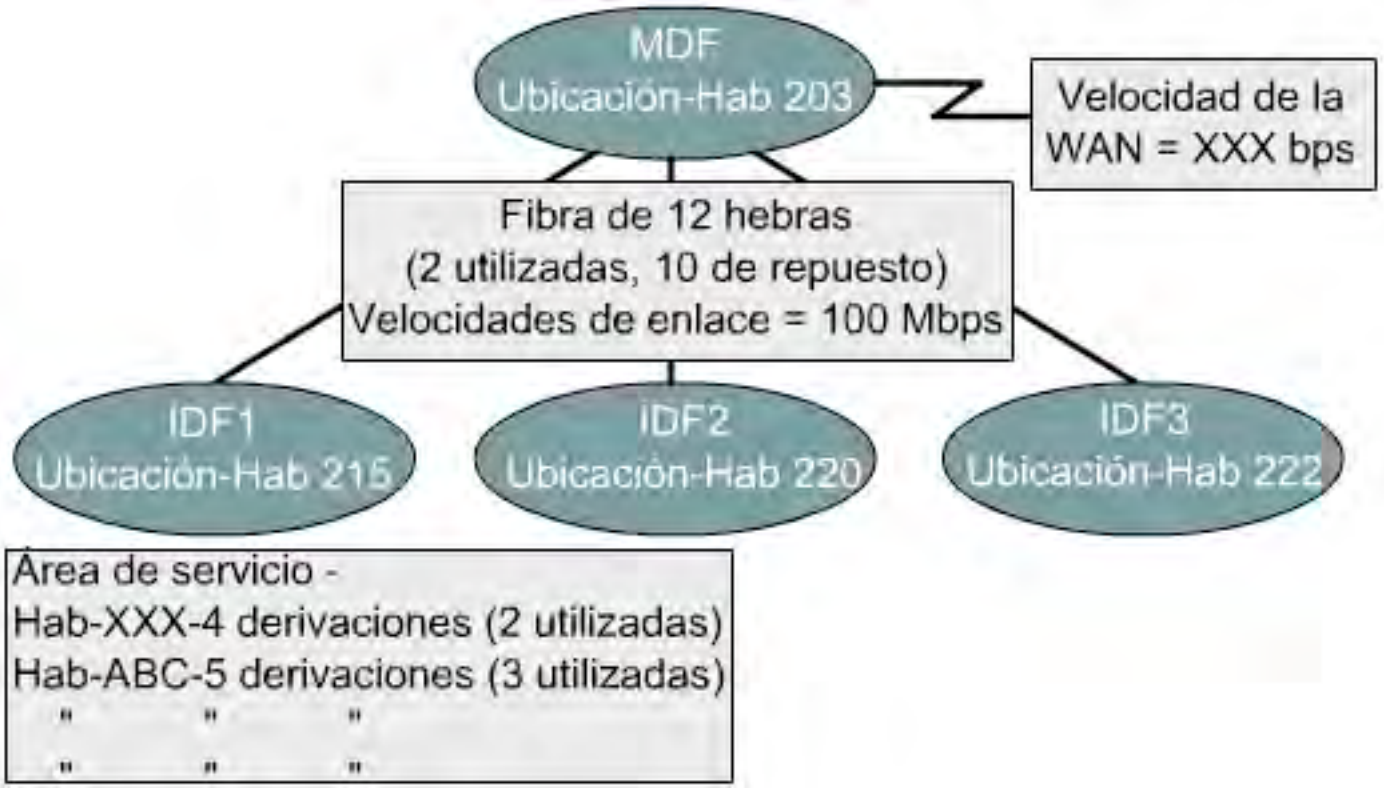


Terminología para 2 capas



Documentación: diagrama lógico

- Topología sin detalles de ruta de instalación exacta
- Indica la ubicación de los centros de cableado
- El tipo y cantidad de cableado de interconexión
- La cantidad de cables libres

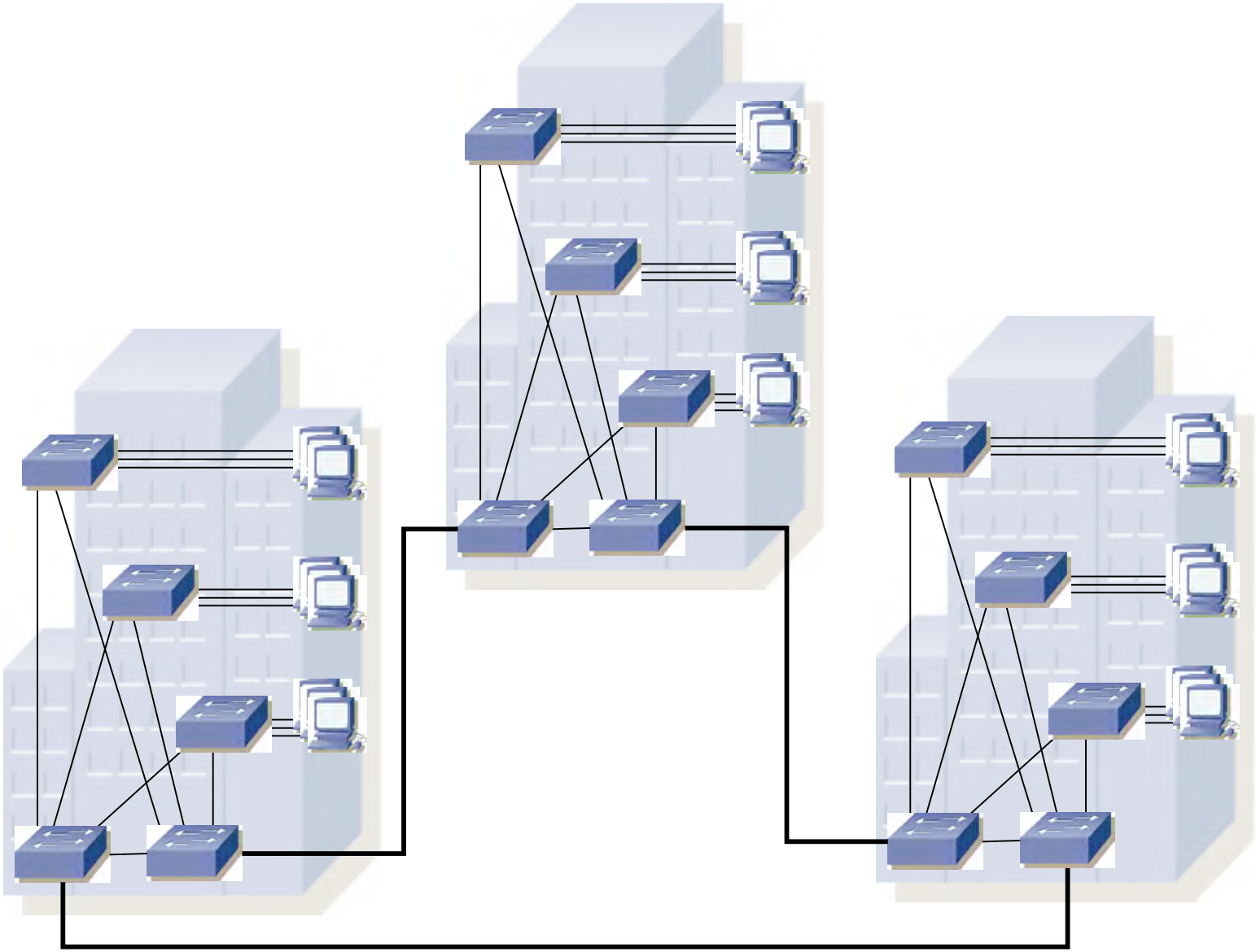


Documentación: plan de distribución

- Documentación detallada sobre los tendidos de cable

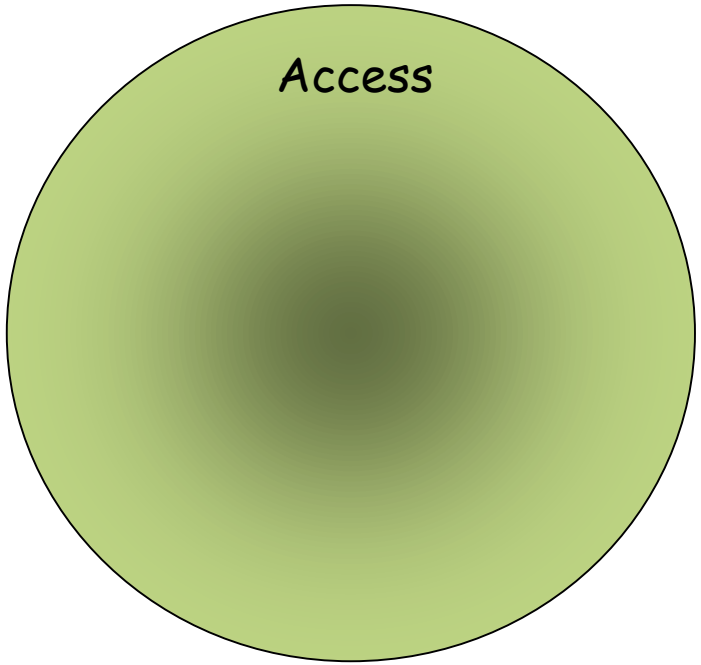
Conexión	ID de cable	Conexión cruzada Par Nº/Puerto Nº	Tipo de Cable	Estado
IDF1 a Hab 203	203-1	HCC1/Puerto 13	UTP Categoria 5	Utilizado
IDF1 a Hab 203	203-2	HCC1/Puerto 14	UTP Categoría 5	No se utiliza
IDF1 a Hab 203	203-3	HCC1/Puerto 3	UTP Categoría 5	No se utiliza
IDF1 a MDF	IDF1-1	VCC1/Puerto 1	Fibra multimodo	Utilizado
IDF1 a MDF	IDF1-2	VCC1/Puerto 2	Fibra multimodo	Utilizado

Terminología para 2 capas



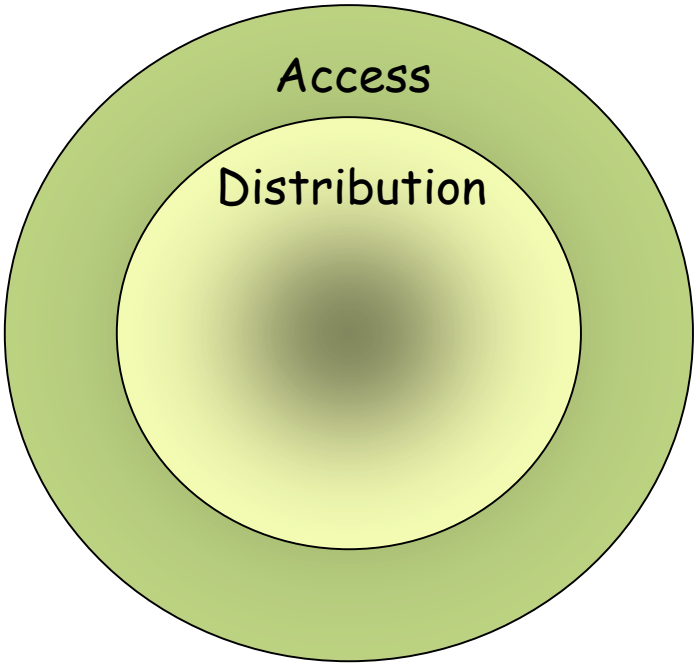
Terminología para 3 capas

- **Access**
  - Acceso de los usuarios a la red
  - Usuarios locales o remotos
  - Debe dar acceso solo a usuarios autorizados
  - IDF



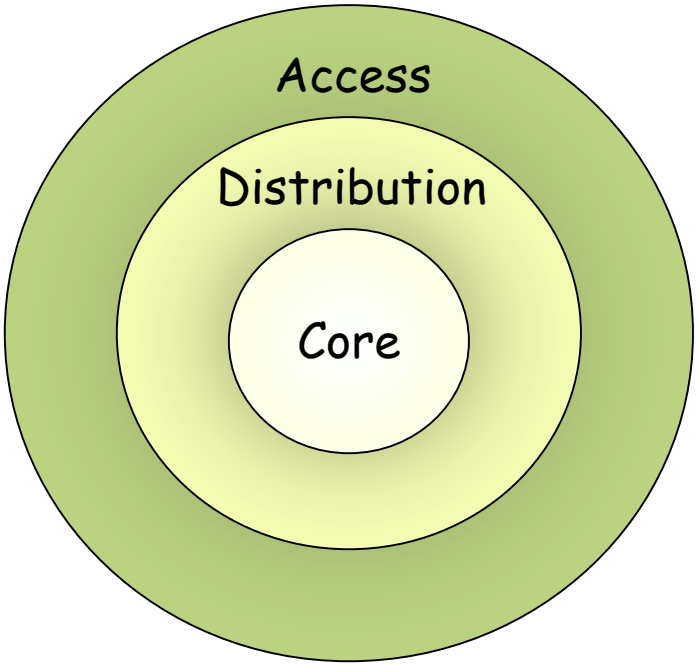
Terminología para 3 capas

- **Distribution**
  - Conexión entre grupos de trabajo y de ellos al núcleo
  - Agrega accesos de baja velocidad en enlaces de alta velocidad
  - Aplica políticas de filtrado y prioridad de tráfico
  - Resumir rutas
  - Ofrecer conexiones redundantes
  - MDF



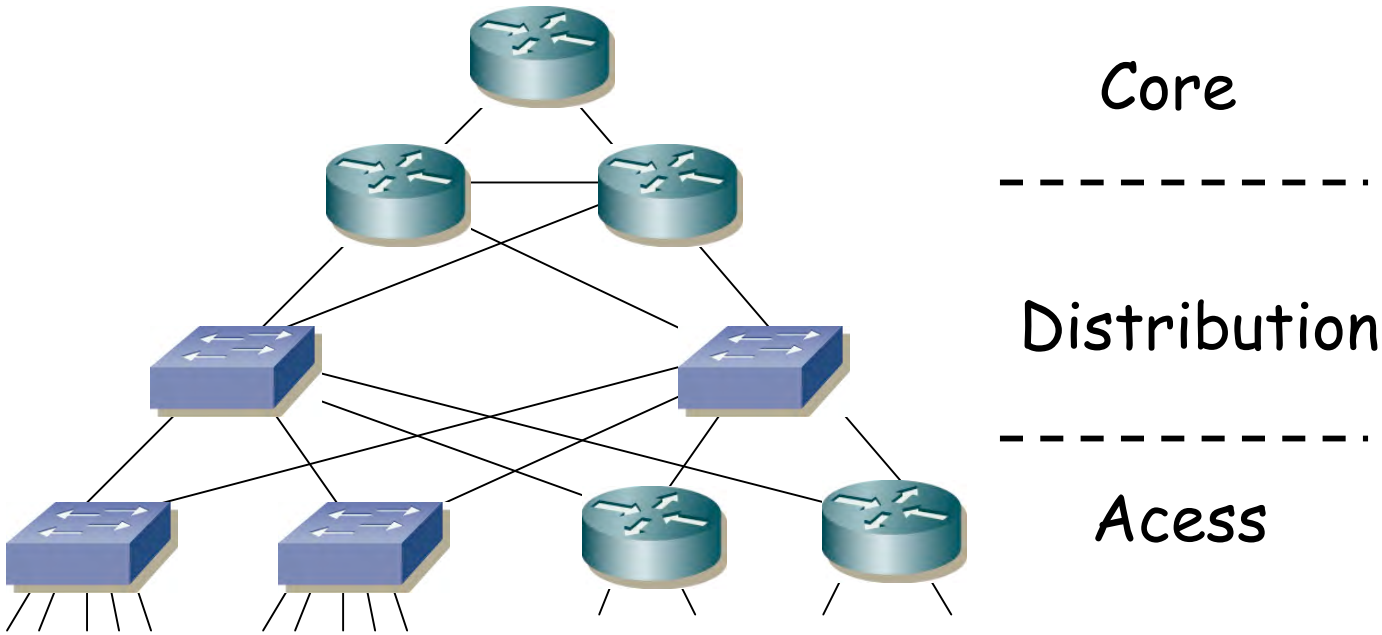
Terminología para 3 capas

- **Core**
  - Backbone de alta velocidad y baja latencia
  - Alta disponibilidad (redundancia)
  - Transporte entre los dispositivos de distribución
  - Rápida adaptación a cambios en el enrutamiento



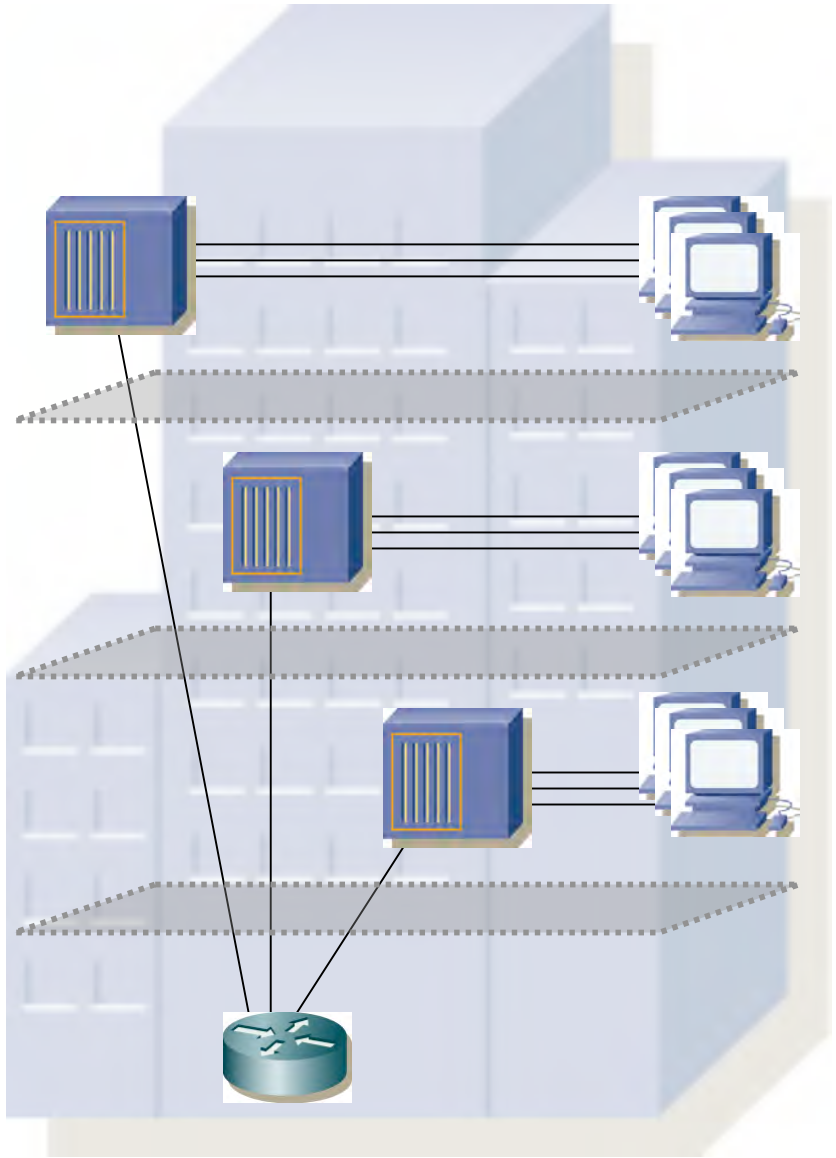
Terminología para 3 capas

- **Access**: Acceso de los usuarios a la red
- **Distribution**: Conexión entre grupos de trabajo y de ellos al núcleo
- **Core**: Transporte de alta velocidad entre los dispositivos de distribución



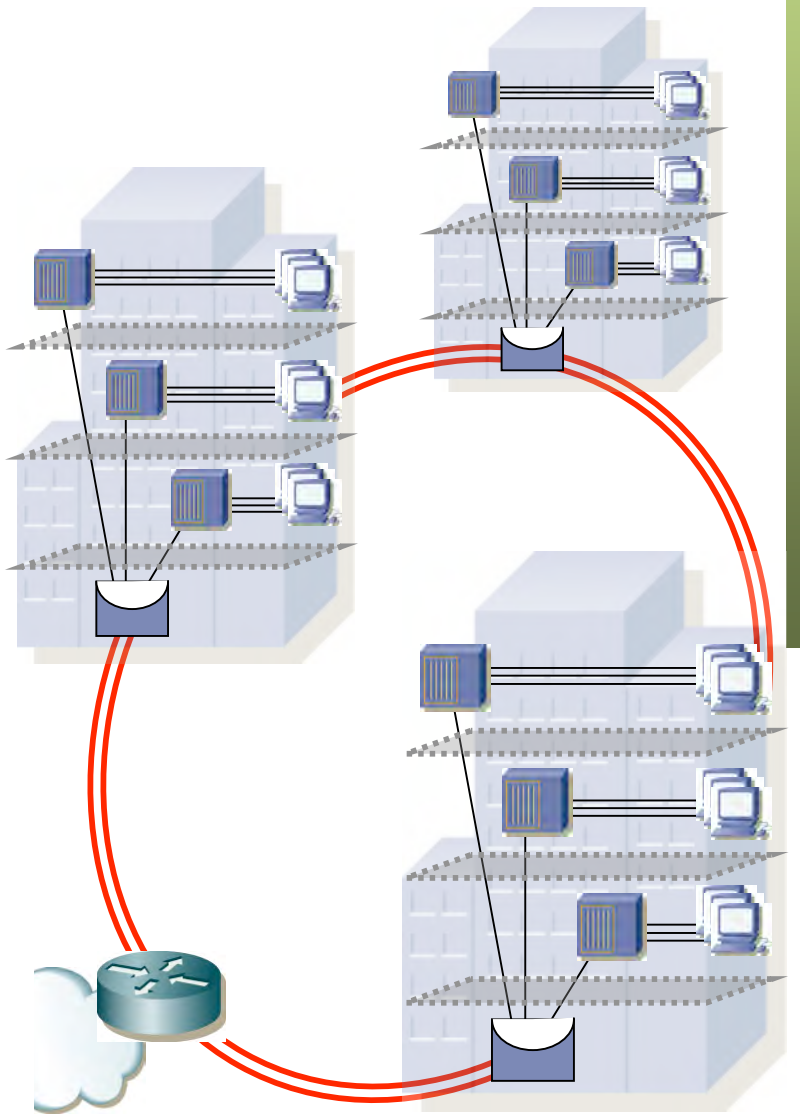
Modelos

Hub y router



Hub y router

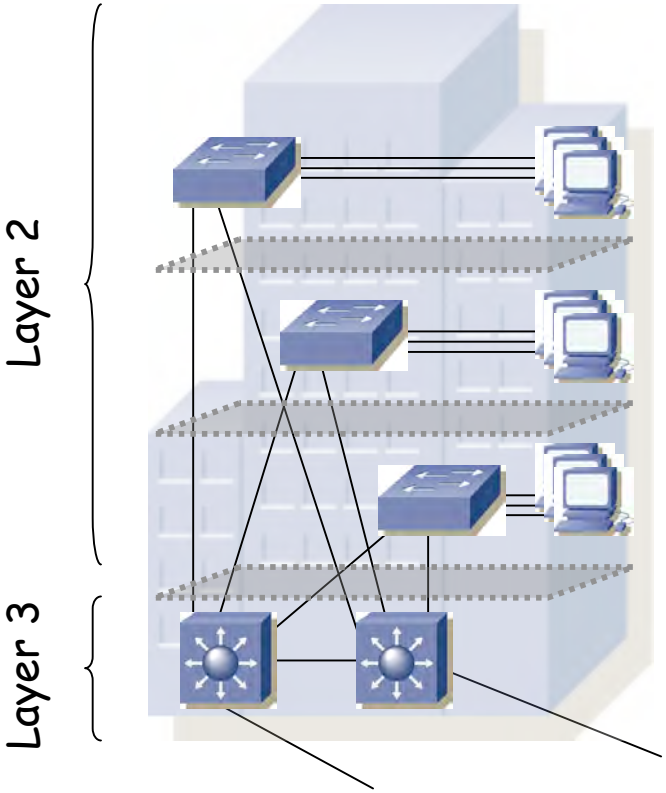
- Bajo ancho de banda
- Asume que la mayor parte del tráfico es local al hub

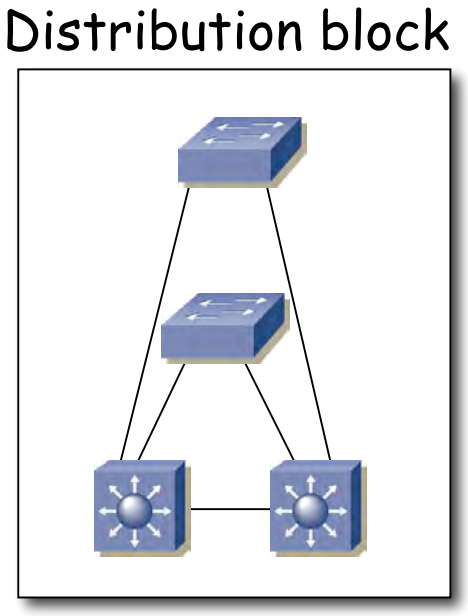


Campus-wide VLAN

Modelo multicapa

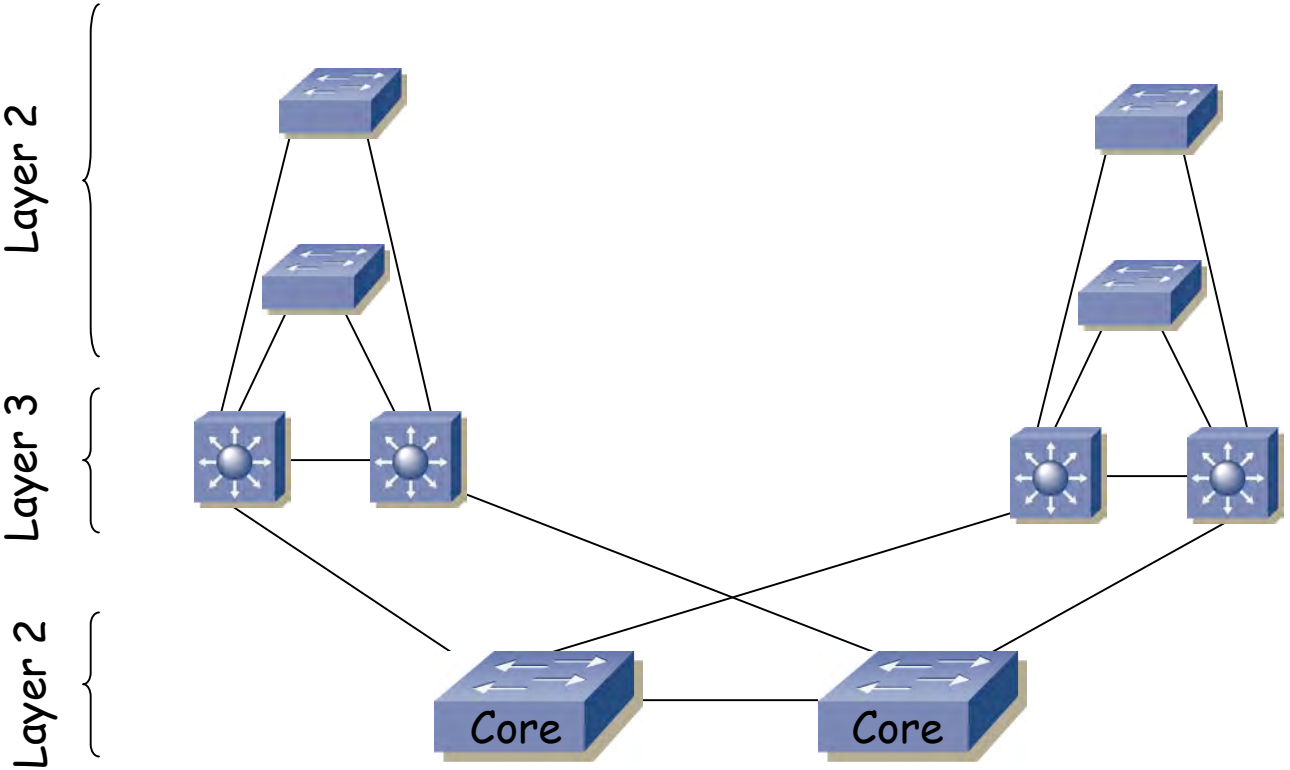
Modelo multicapa



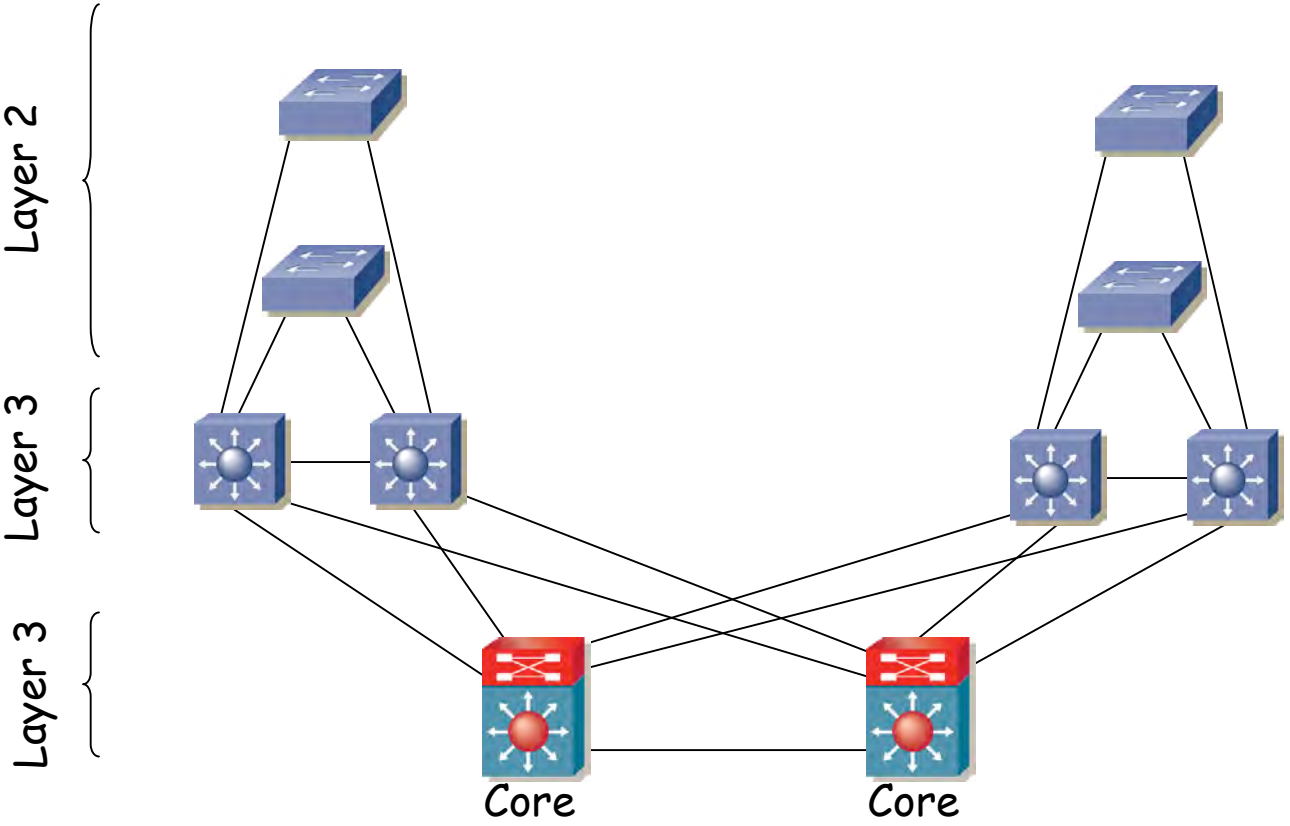


- MDF layer 3
- Pone límite a VLANs y broadcasts

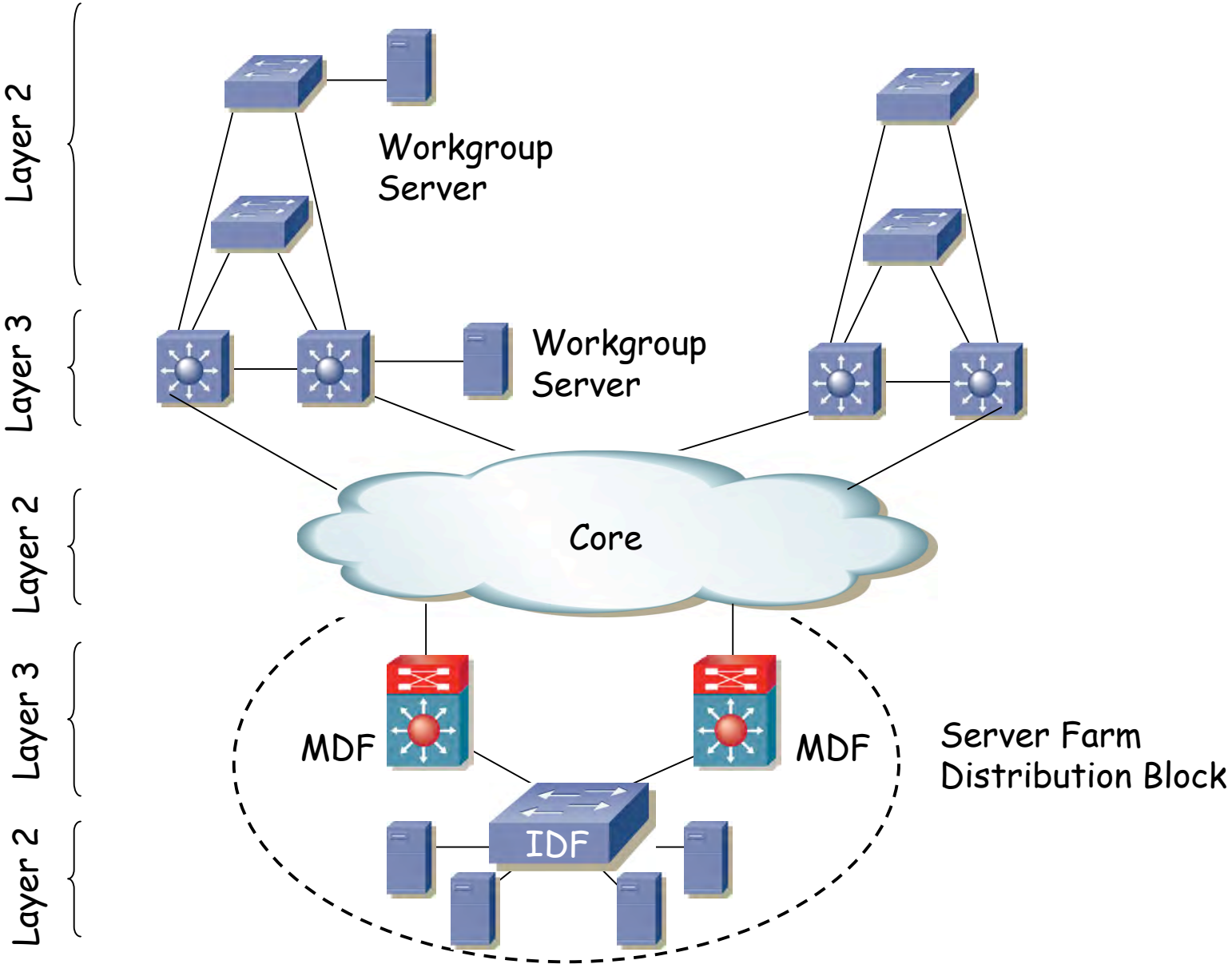
Modelo multicapa



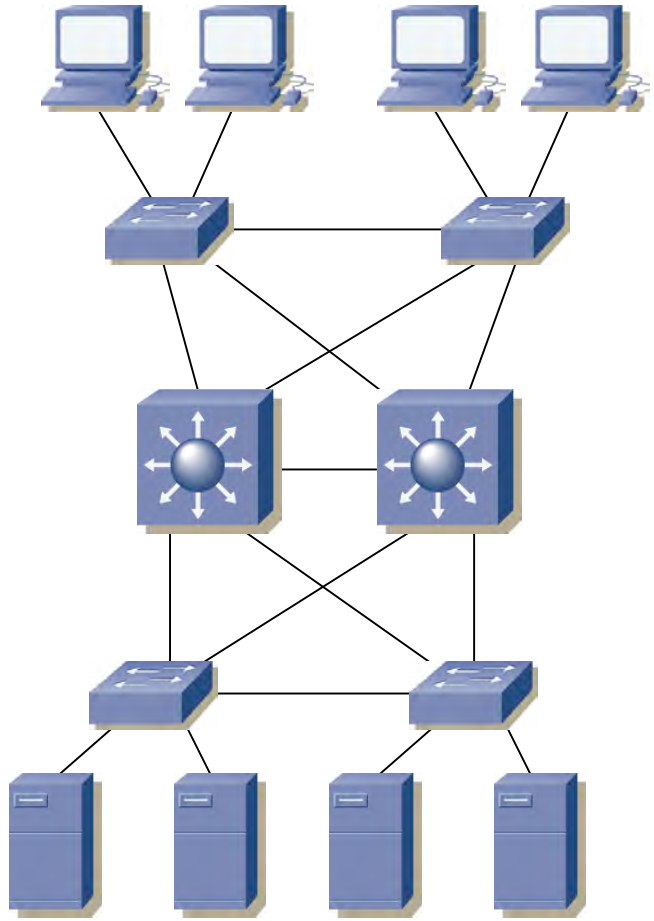
Modelo multicapa



Modelo multicapa



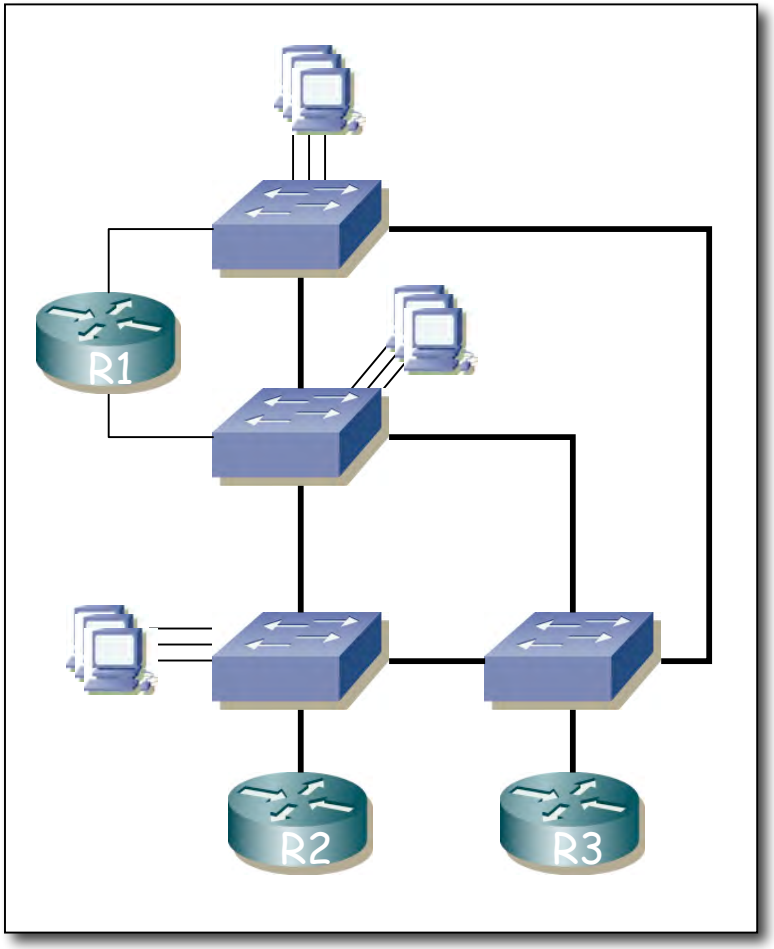
Ejemplo

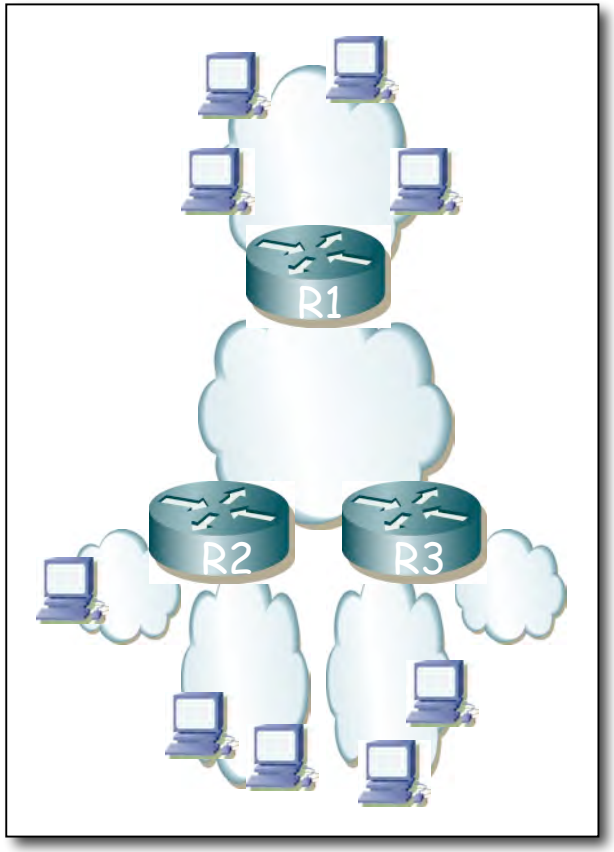


- Acceso
- Distribución y núcleo (*collapsed backbone*)
- Servidores

Topologías de nivel 1-2 y 3

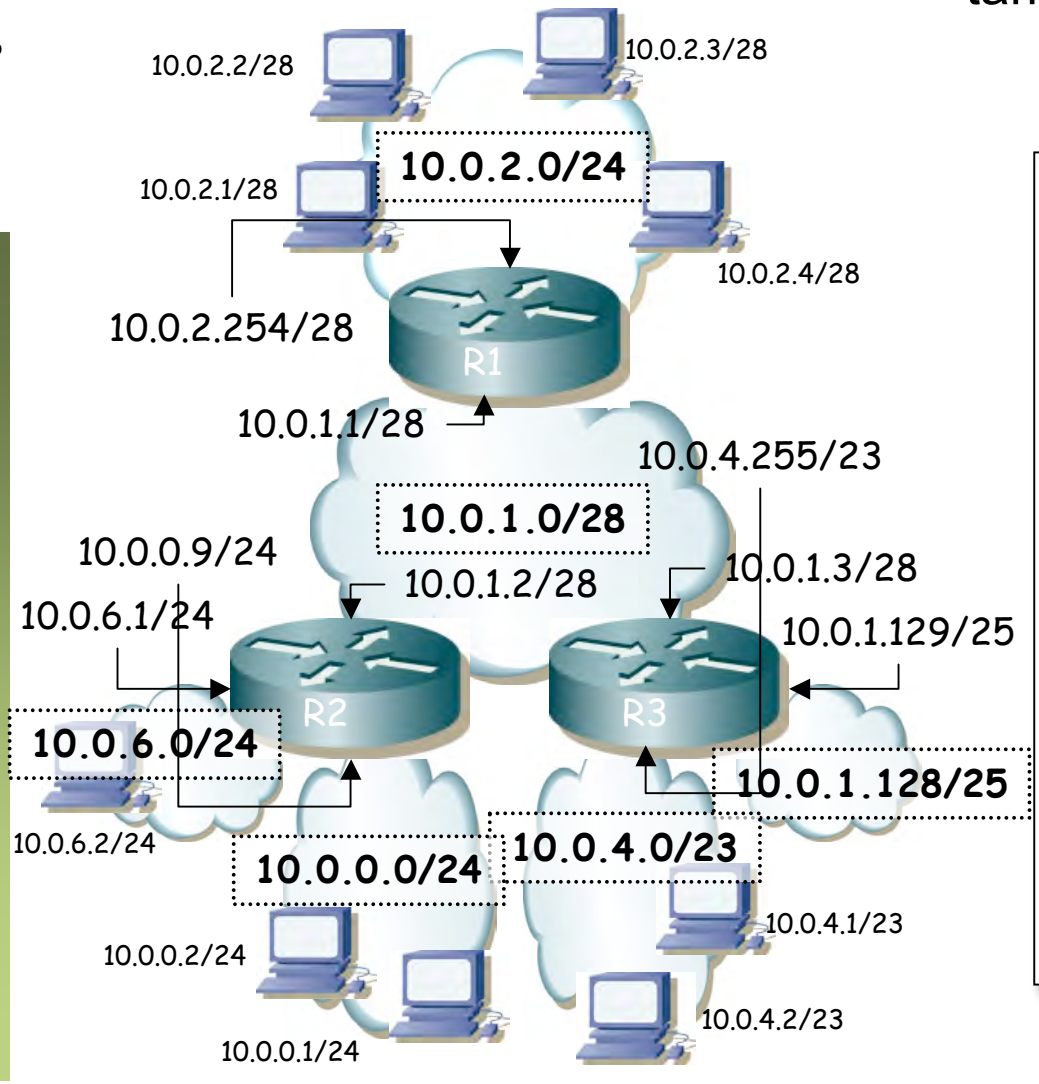
- Con VLANs puede ser difícil reconocer la topología de nivel 3
- Recomendable tener también la visión del nivel 3

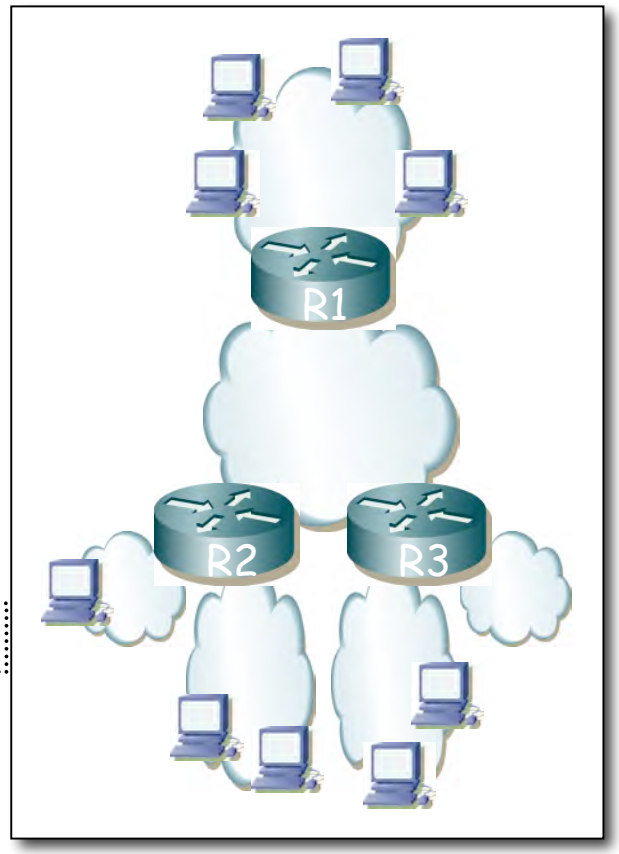




Topologías de nivel 1-2 y 3

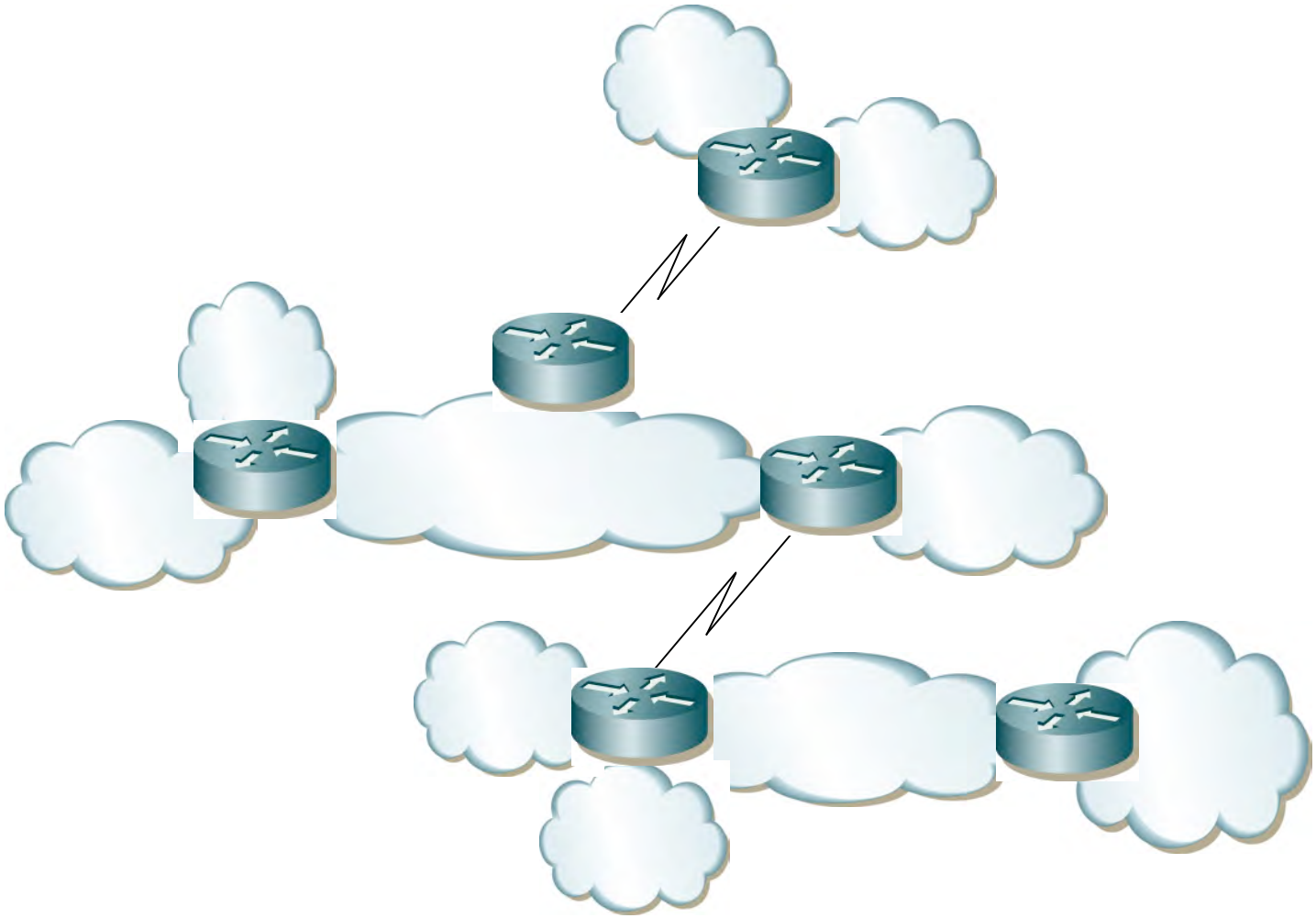
- Incluido el direccionamiento
- Recomendable tener también la visión del nivel 3





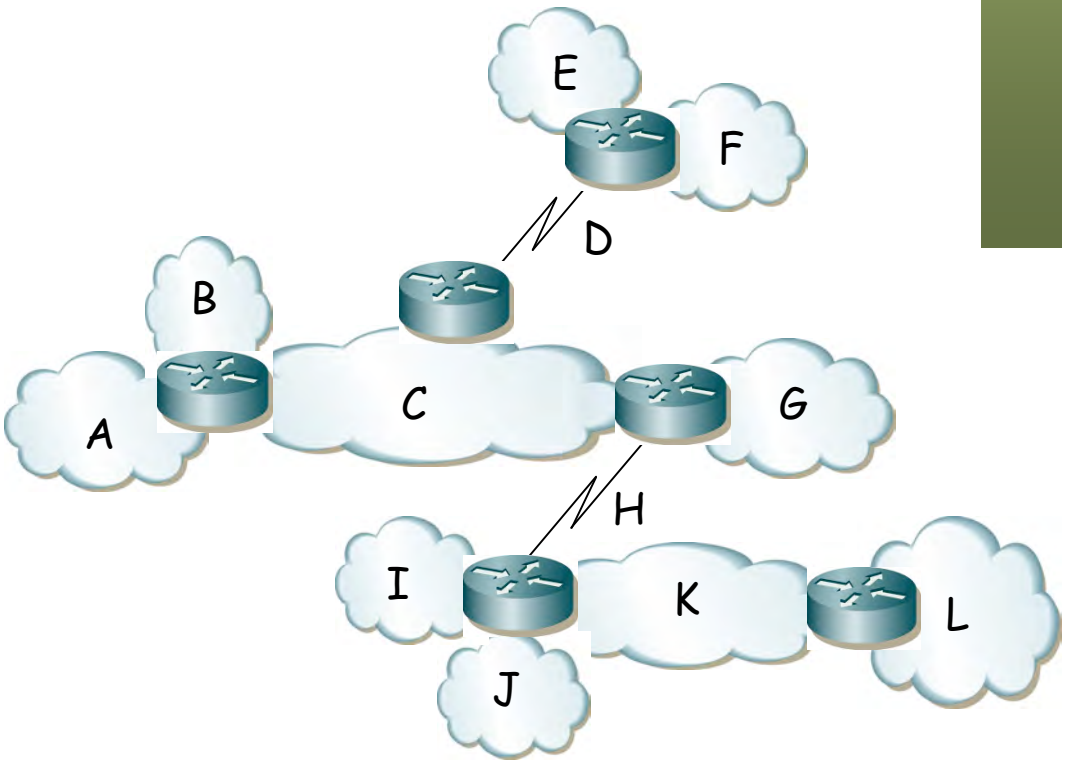
Direccionamiento

Ejemplo



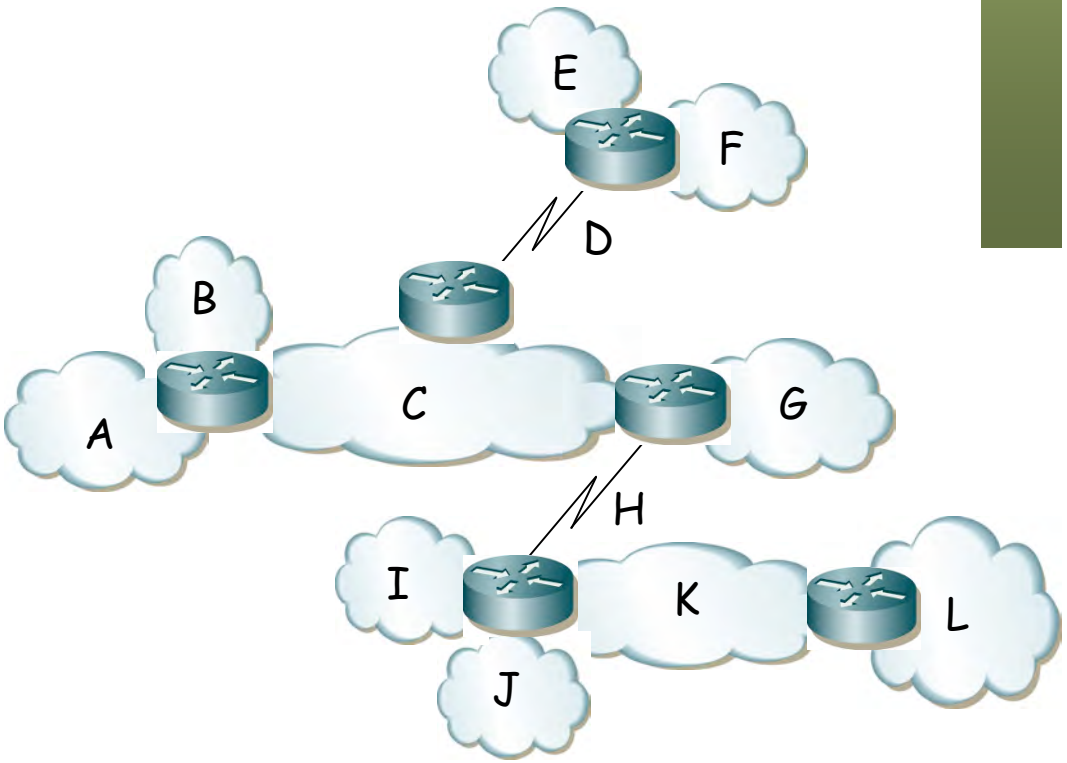
Ejemplo

- Máscaras de longitud constante
- 12 Subredes
- Máximo 10 hosts por red
- Red 192.168.3.0/24



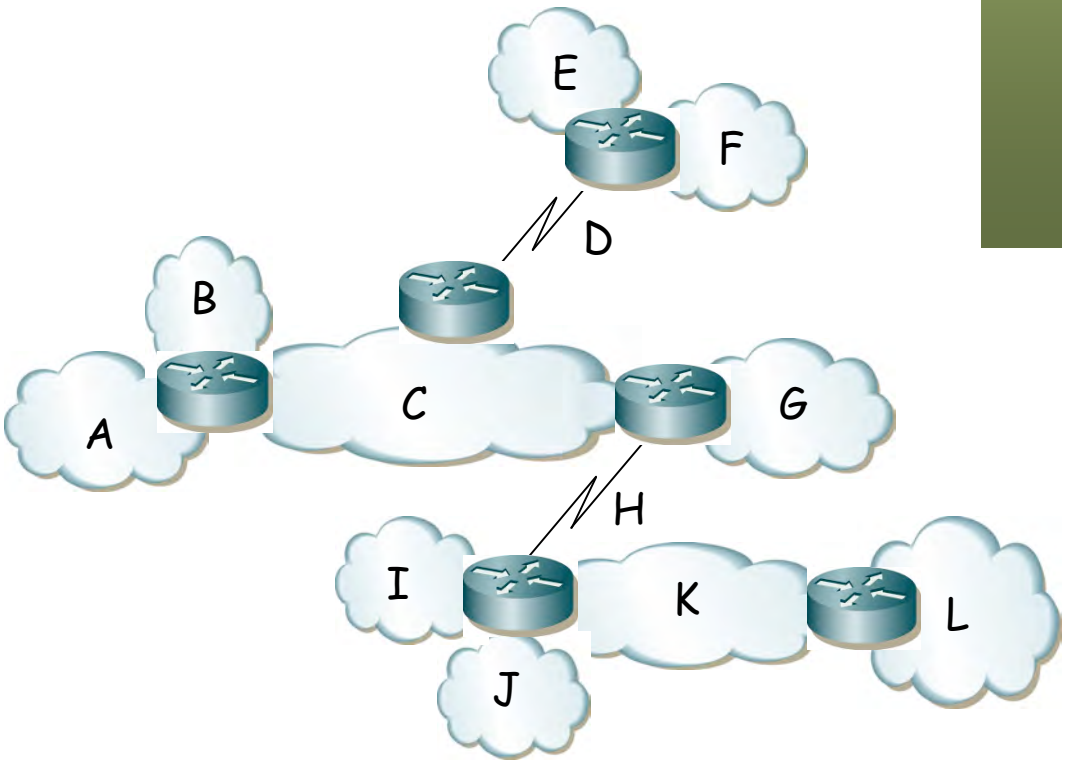
Ejemplo

- Máscaras de longitud constante
- 12 Subredes → 2^4=16, 4 bits subnetwork-id
- Máximo 10 hosts por red
- Red 192.168.3.0/24



Ejemplo

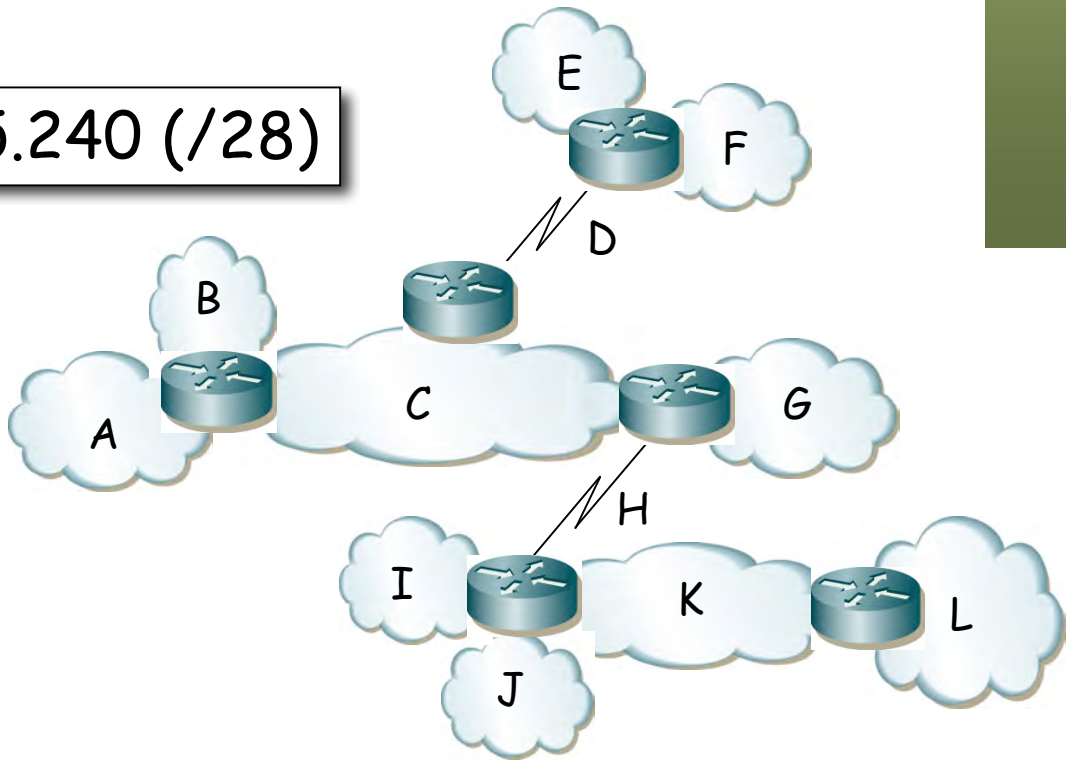
- Máscaras de longitud constante
- 12 Subredes → 2^4=16, 4 bits subnetwork-id
- Máximo 10 hosts por red (+2) → 2^4=16, 4 bits host-id
- Red 192.168.3.0/24



Ejemplo

- Máscaras de longitud constante
- 12 Subredes → 2^4=16, 4 bits subnetwork-id
- Máximo 10 hosts por red (+2) → 2^4=16, 4 bits host-id
- Red 192.168.3.0/24 → 192.168.3. [0000] [0000]

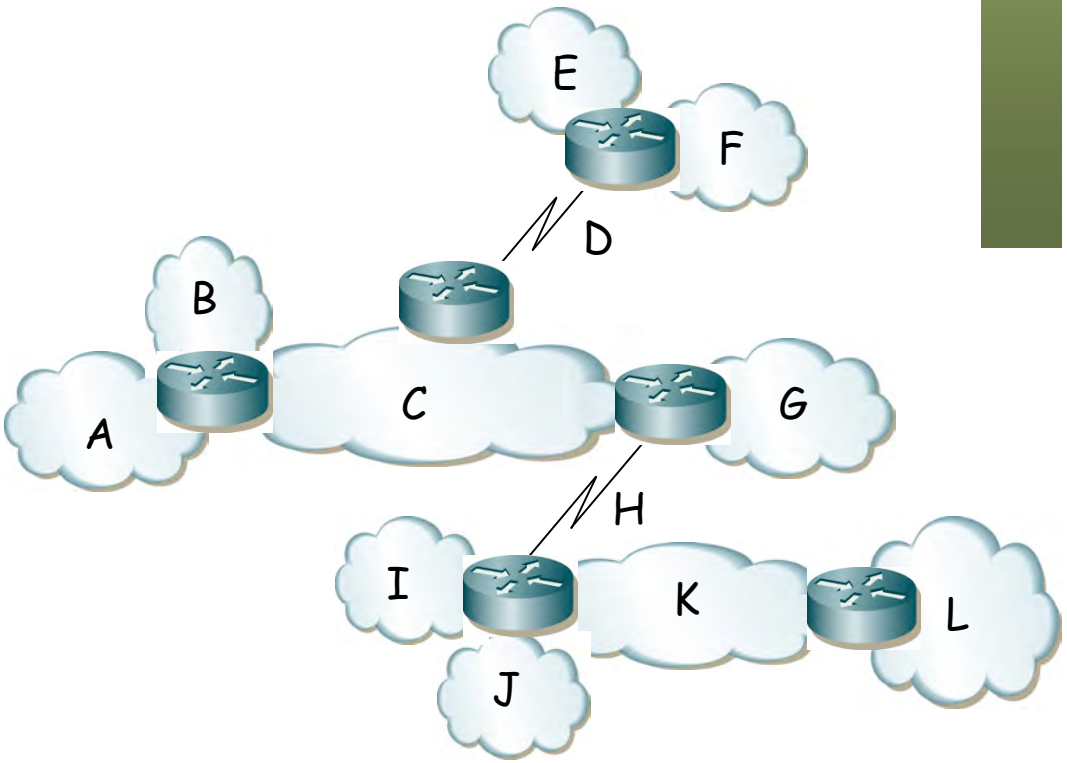
Máscara 255.255.255.240 (/28)



Ejemplo

A	192.168.3	.	[0000]	[0000]	= 192.168.3.0
B	192.168.3	.	[0001]	[0000]	= 192.168.3.16
C	192.168.3	.	[0010]	[0000]	= 192.168.3.32
.	.	.	.	.	.
.	.	.	.	.	.
O	192.168.3	.	[1111]	[0000]	= 192.168.3.240

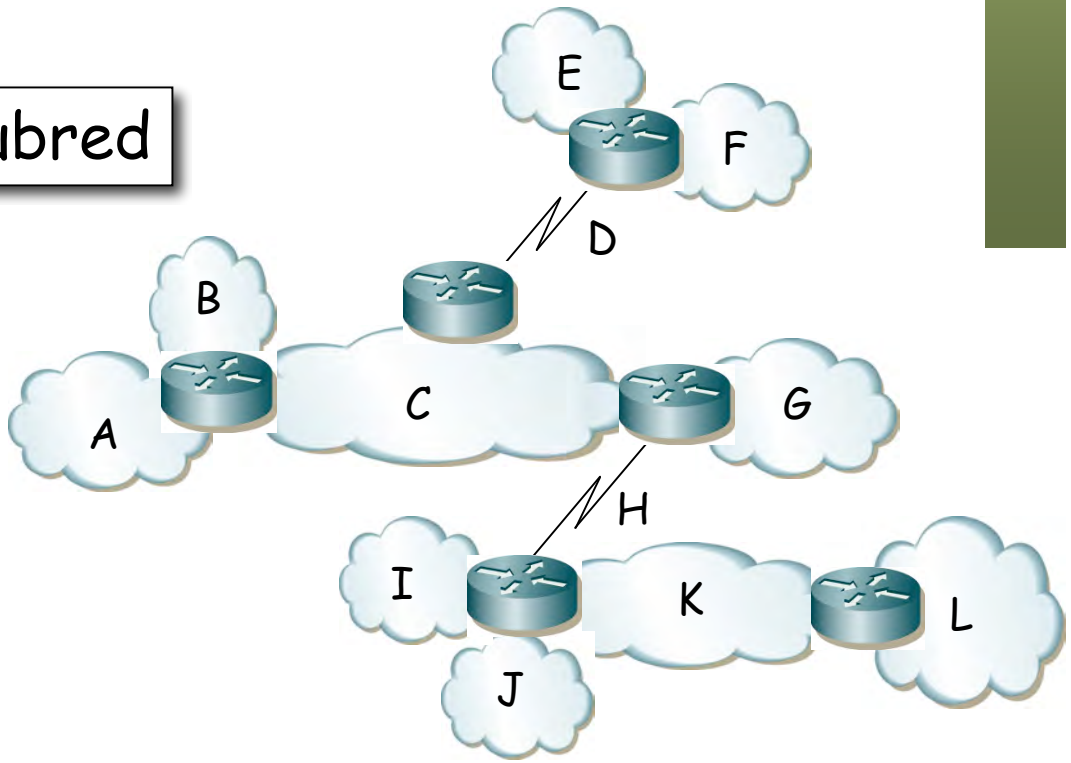
Subredes



Ejemplo

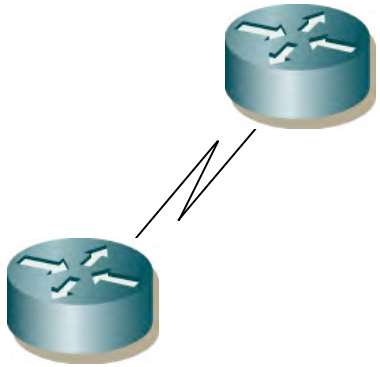
192.168.3	.	[0010]	[0000]	= 192.168.3.32 (Dirección de subred)
192.168.3	.	[0010]	[0001]	= 192.168.3.33
192.168.3	.	[0010]	[0010]	= 192.168.3.34
.	.	.	.	.
.	.	.	.	.
192.168.3	.	[0010]	[1111]	= 192.168.3.47 (Dirección de broadcast)

Direcciones en una subred



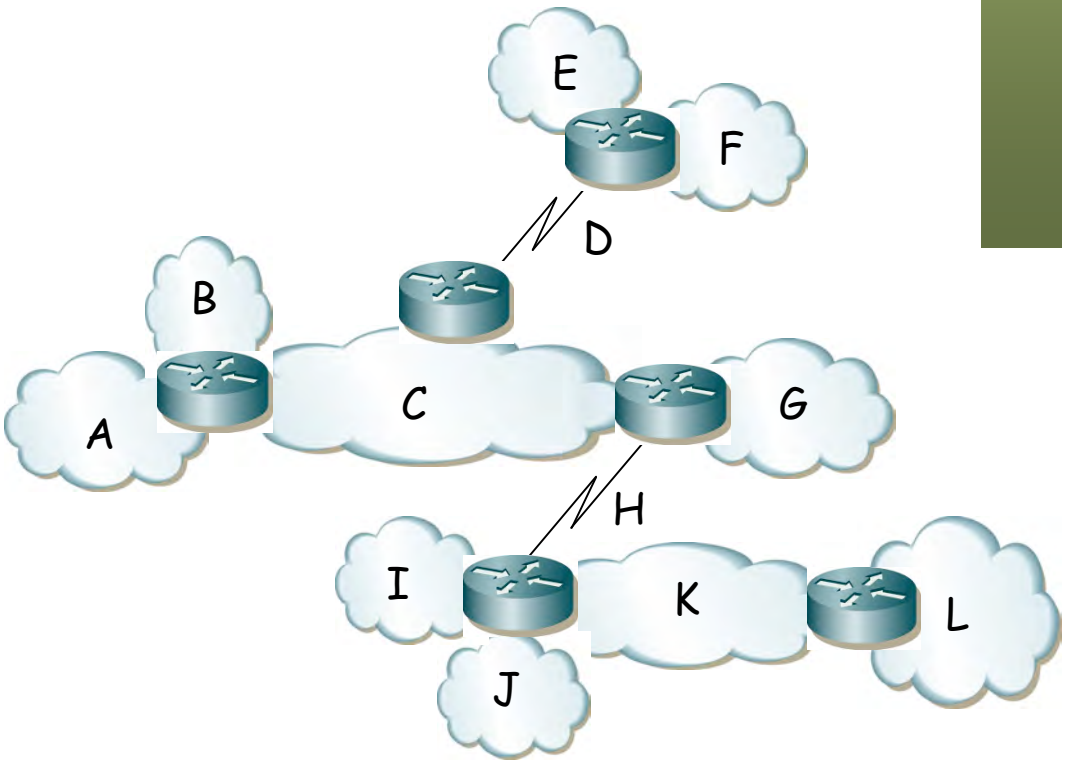
Enlaces serie

- Solo puede haber 2 máquinas
- RFC 3021 permite crear subredes /31 con 2 hosts
- Desaparece la dirección de broadcast dirigido
- Para los hosts de la red aún queda la dirección de broadcast limitado (255.255.255.255)
- La dirección de red no crea confusión en CIDR
- RFC 3021 permite crear subredes /31 con 2 hosts
- Los equipos deben soportarlo
- Por seguridad seguiremos empleando máscaras /30



Ejemplo (2)

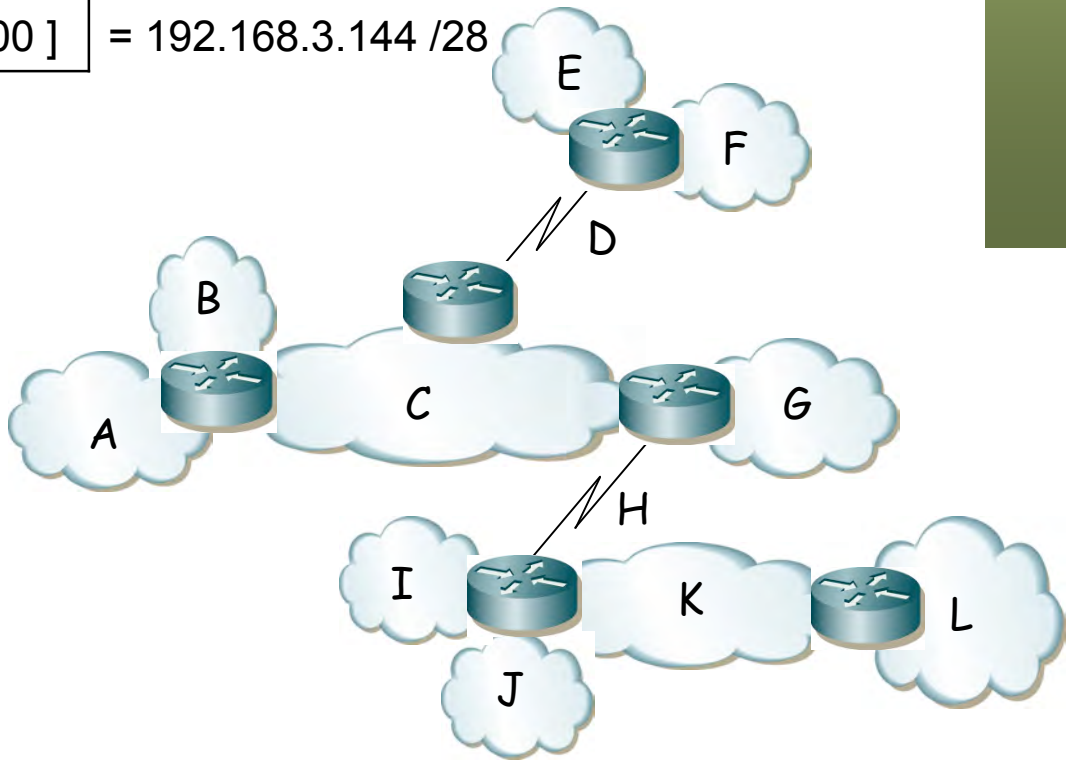
- Máscaras de longitud variable (VLSM o CIDR)
- Red D y H no van a necesitar más de 2 direcciones
- 10 redes de 10 hosts



Ejemplo (2)

- 10 redes de 10 hosts

A	192.168.3	.	[0000]	[0000]	= 192.168.3.0 /28
B	192.168.3	.	[0001]	[0000]	= 192.168.3.16 /28
C	192.168.3	.	[0010]	[0000]	= 192.168.3.32 /28
.	.	.	.	.	.
.	.	.	.	.	.
L	192.168.3	.	[1001]	[0000]	= 192.168.3.144 /28



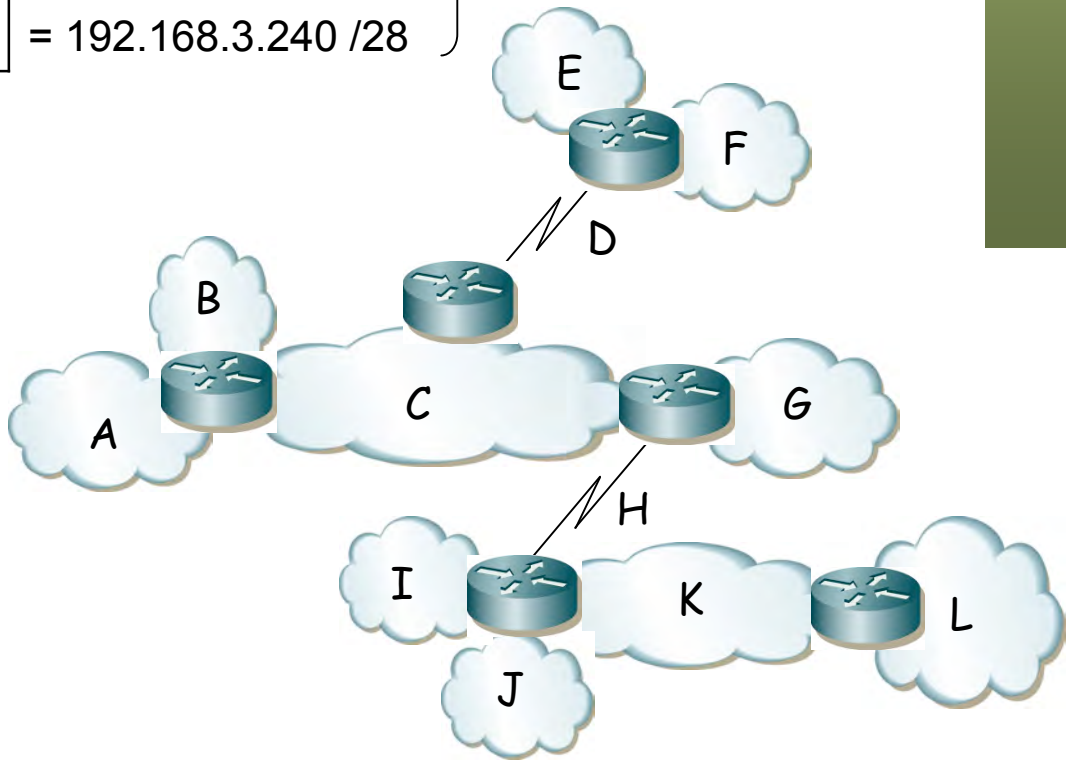
Ejemplo (2)

- Libres:

192.168.3	.	[1010]	[0000]	= 192.168.3.160 /28
192.168.3	.	[1011]	[0000]	= 192.168.3.176 /28
192.168.3	.	[1100]	[0000]	= 192.168.3.192 /28
192.168.3	.	[1101]	[0000]	= 192.168.3.208 /28
192.168.3	.	[1110]	[0000]	= 192.168.3.224
192.168.3	.	[1111]	[0000]	= 192.168.3.240 /28

192.168.3.160 /27

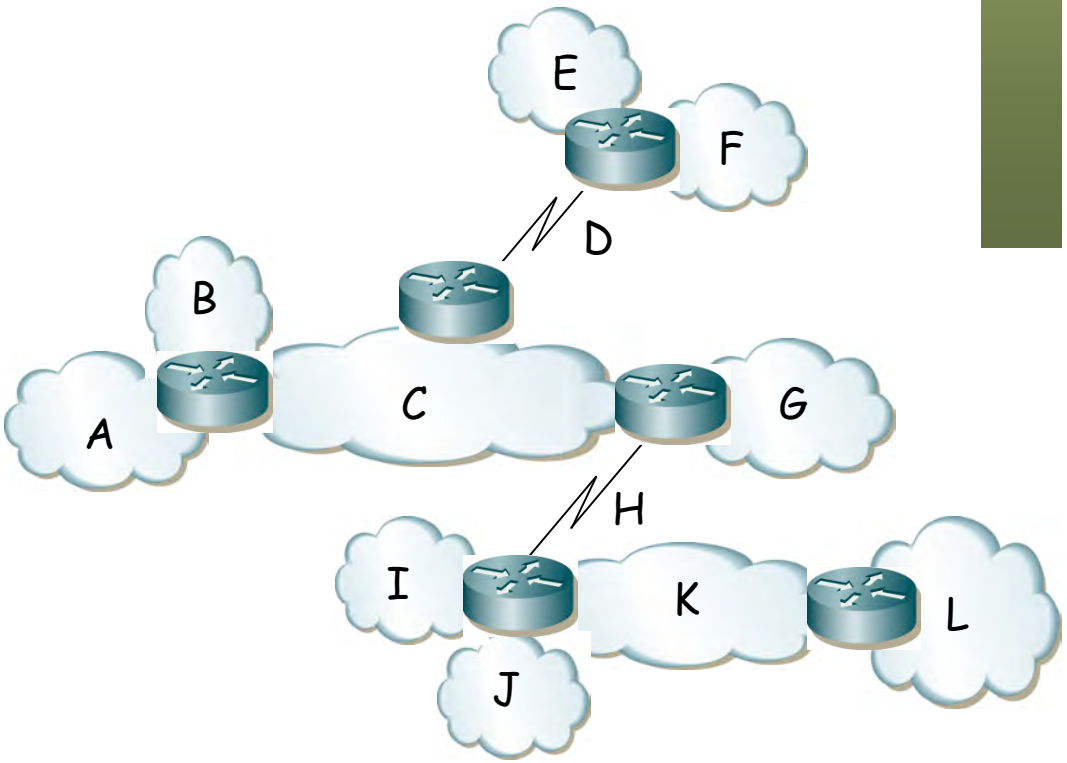
192.168.3.192 /26



Ejemplo (2)

- 2 redes de 2 hosts
- 2 hosts (+2) → 2^2=4, 2 bits para el host-id
- Por ejemplo dentro de 192.168.3.160 /27

D	192.168.3	.	[101]	[000]	[00]	= 192.168.3.160 /30
H	192.168.3	.	[101]	[001]	[00]	= 192.168.3.164 /30



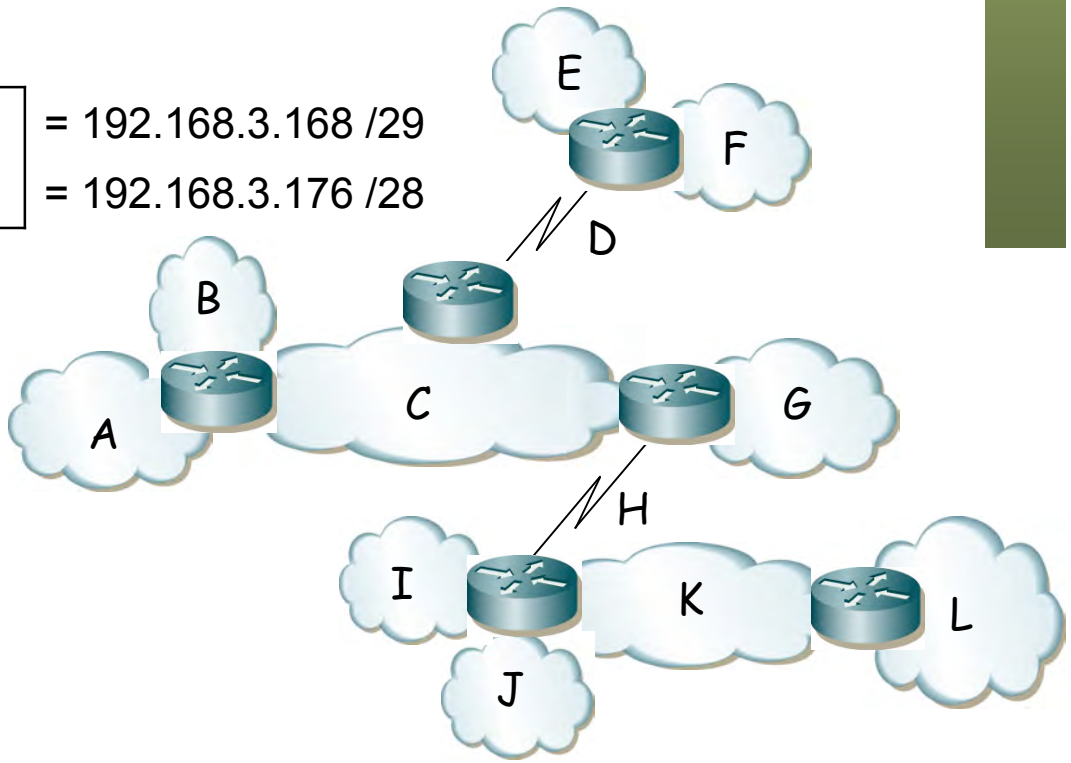
Ejemplo (2)

- 2 redes de 2 hosts
- 2 hosts (+2) → 2^2=4, 2 bits para el host-id
- Por ejemplo dentro de 192.168.3.160 /27

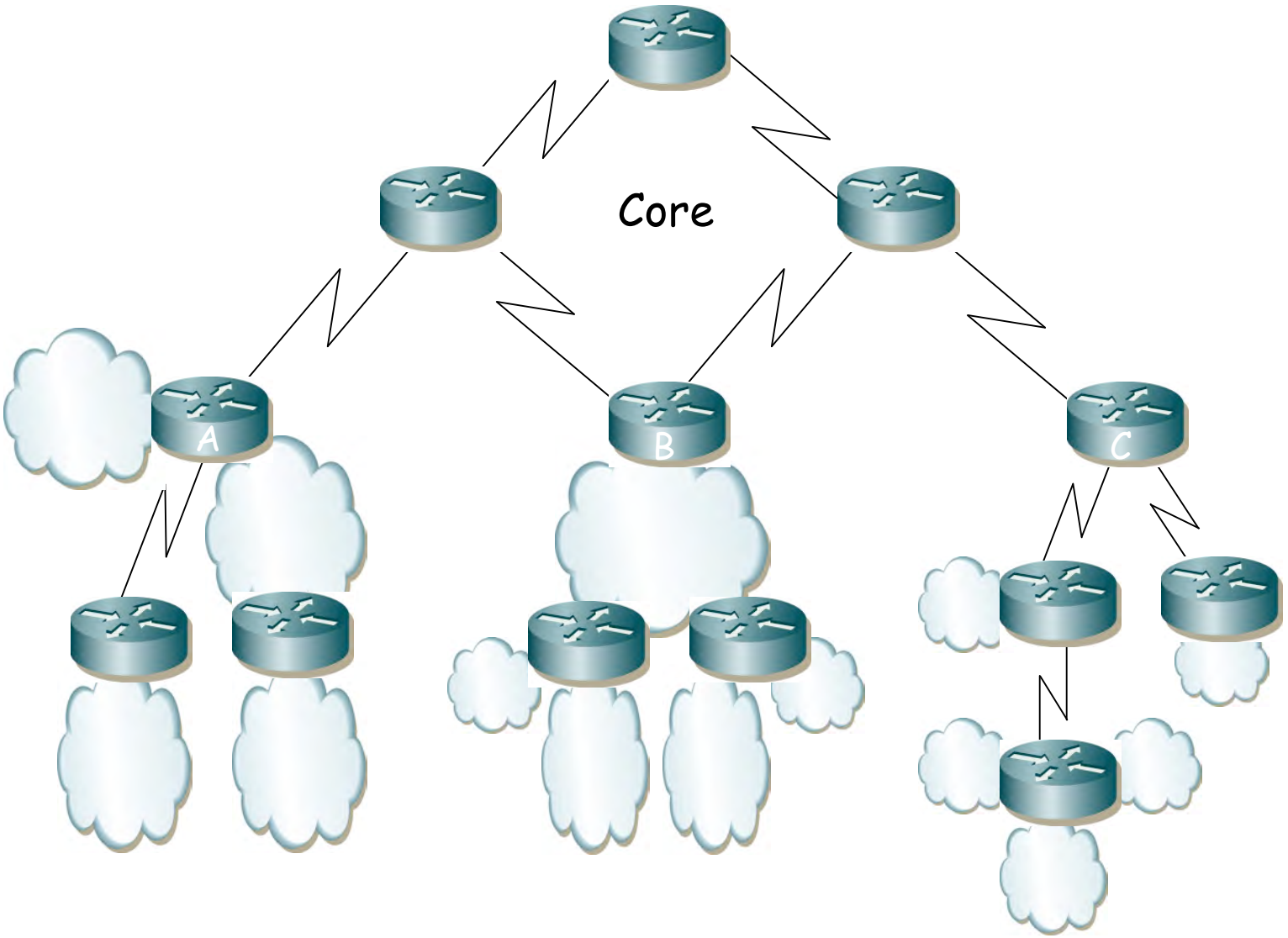
D	192.168.3	.	[101]	[000]	[00]	= 192.168.3.160 /30
H	192.168.3	.	[101]	[001]	[00]	= 192.168.3.164 /30

Libres en 192.168.3.160 /27:

192.168.3	.	[101]	[0 1]	[000]	= 192.168.3.168 /29
192.168.3	.	[101]	[1]	[0000]	= 192.168.3.176 /28

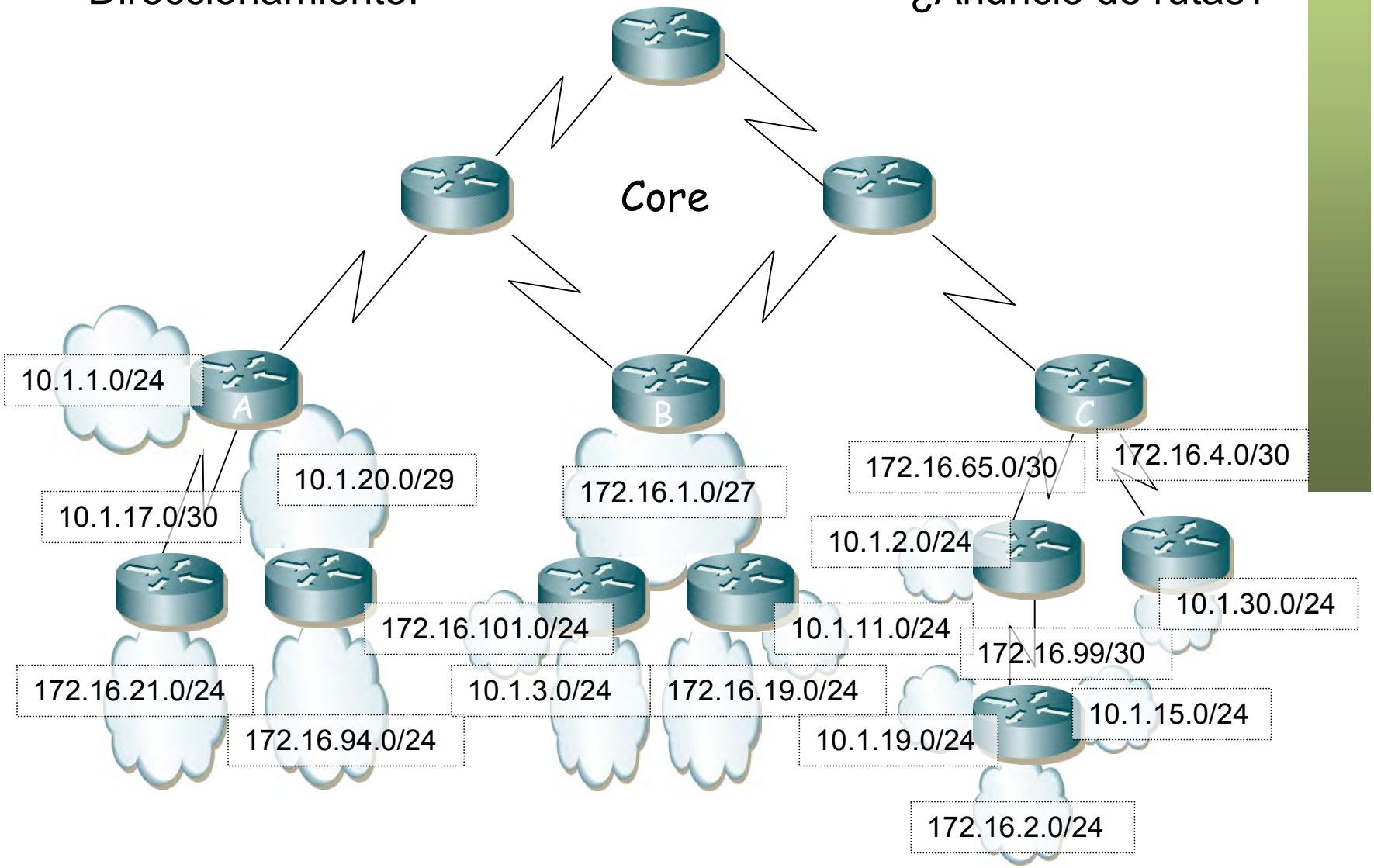


Ejemplo (3)



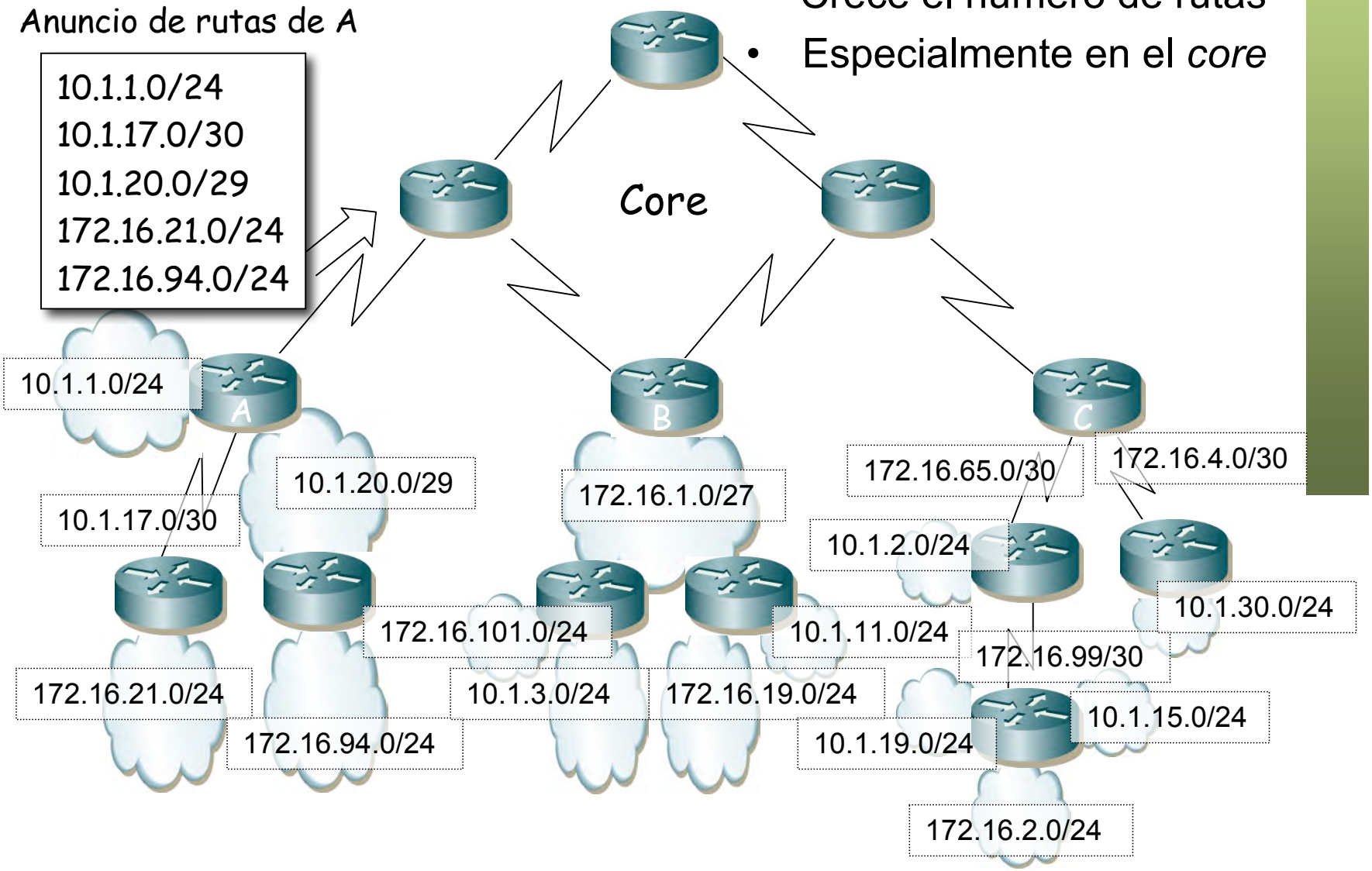
Ejemplo (3)

- Direccionamiento:
- ¿Anuncio de rutas?



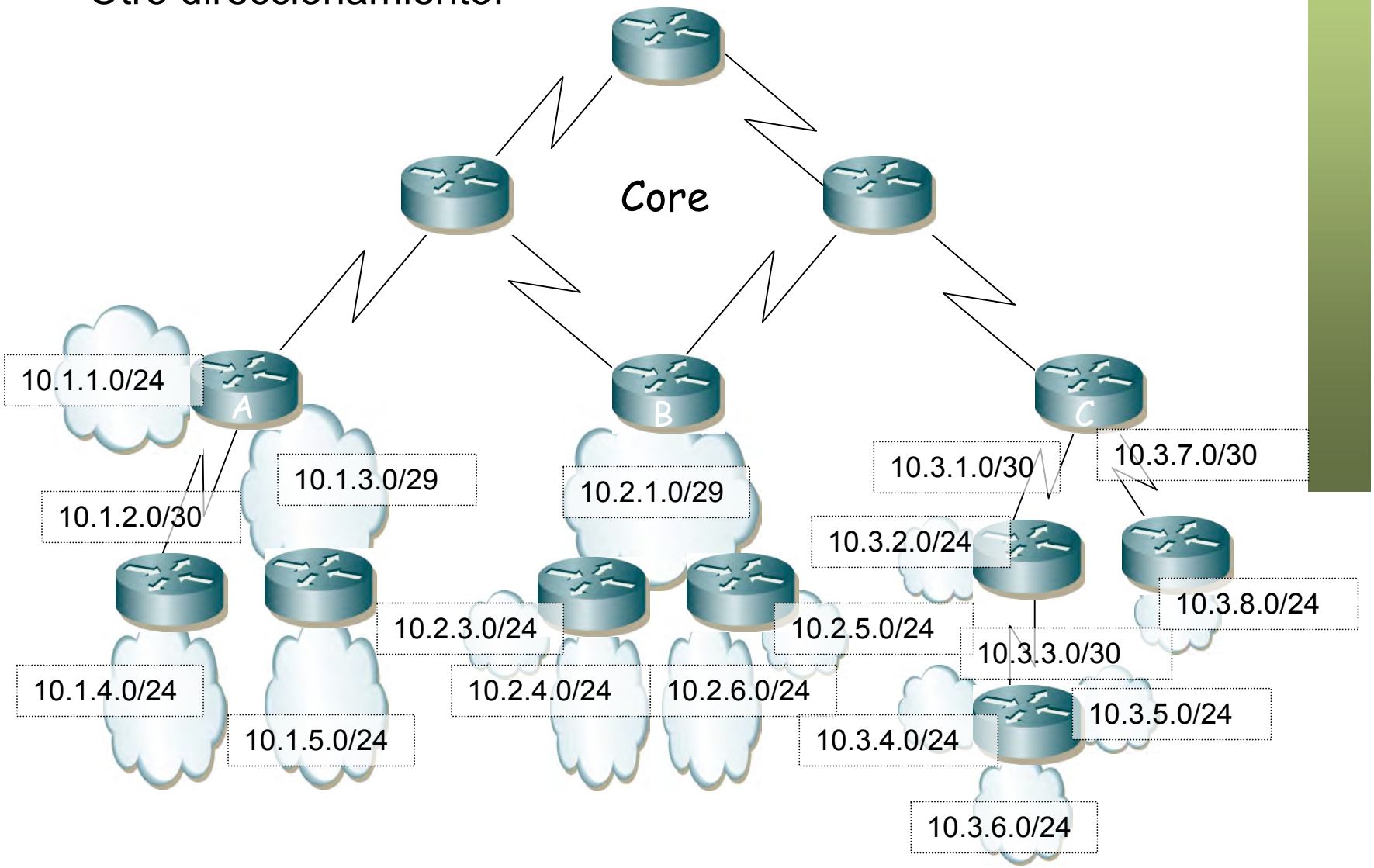
Ejemplo (3)

- Crece el número de rutas
- Especialmente en el *core*



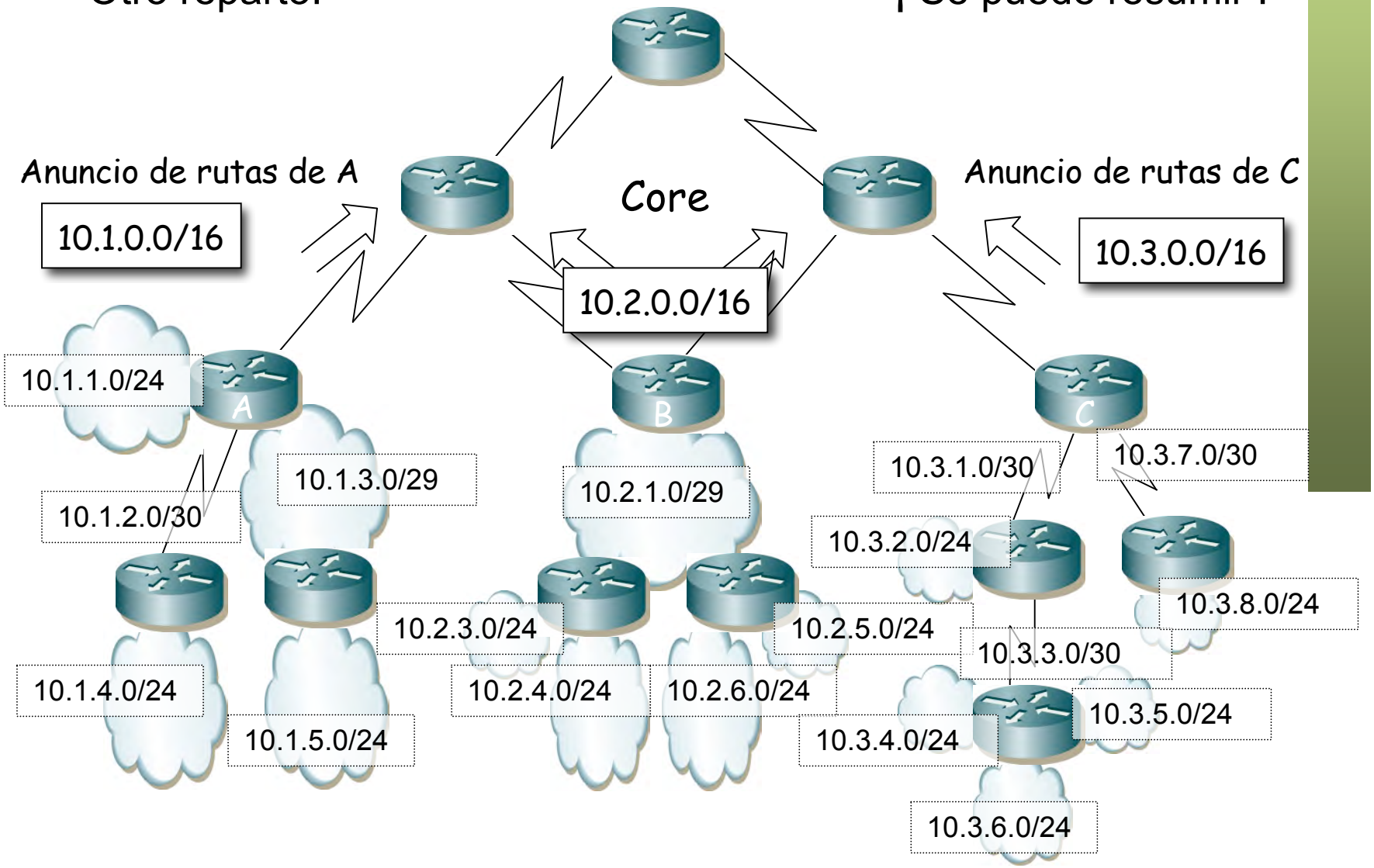
Ejemplo (3)

- Otro direccionamiento:

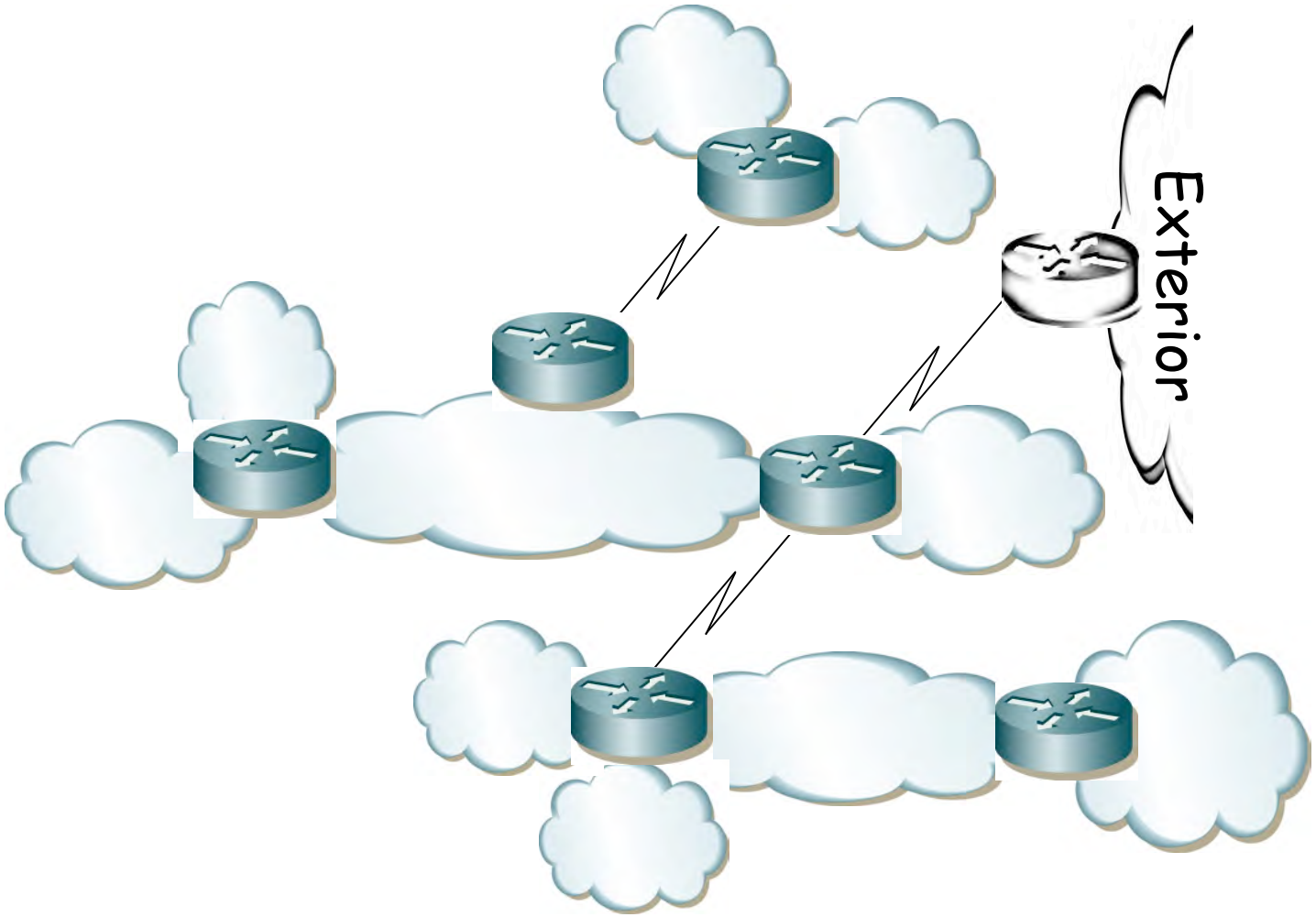


Ejemplo (3)

- Otro reparto:
- ¡ Se puede resumir !

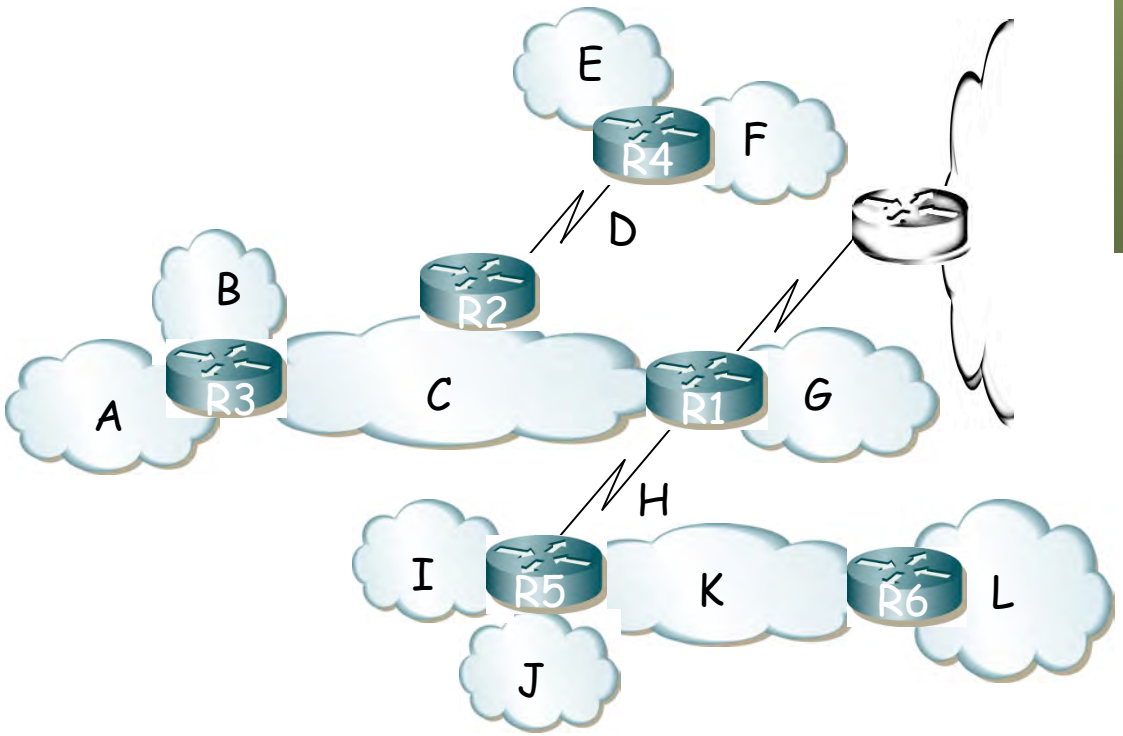


Ejemplo (4)



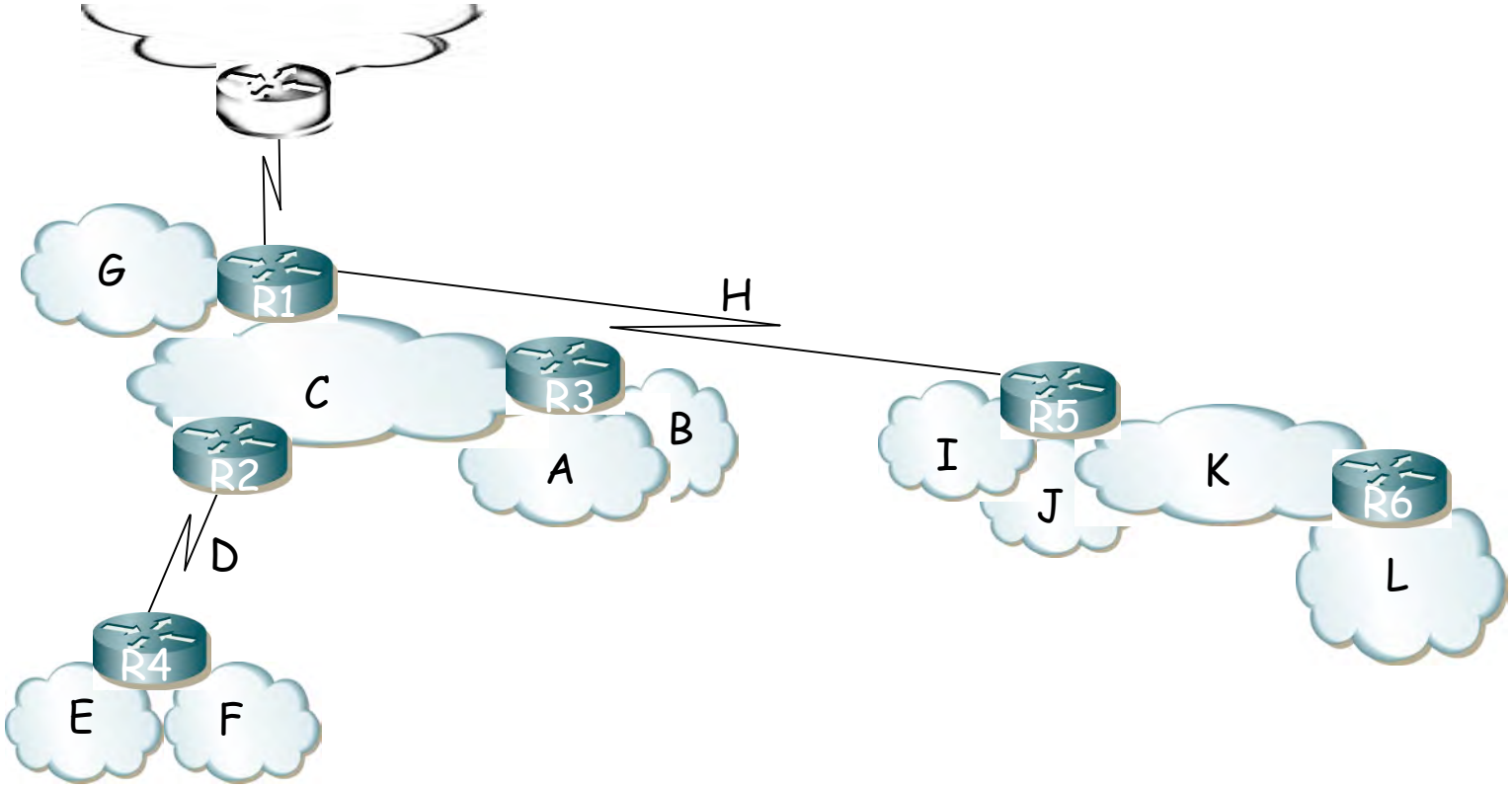
Ejemplo (4)

- 12 Subredes
- Máximo 10 hosts por red
- Red 192.168.3.0/24
- Que se pueda resumir



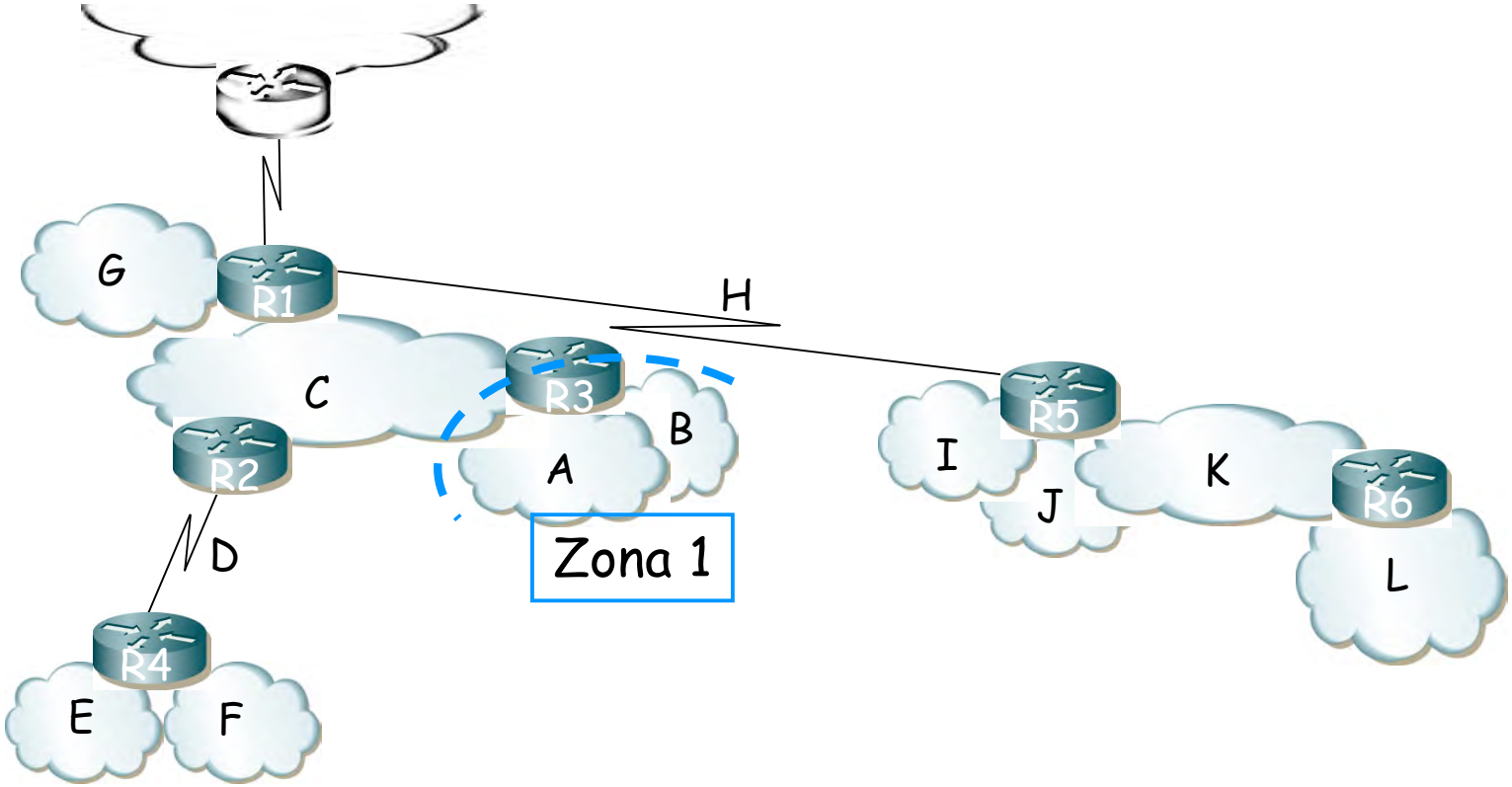
Ejemplo (4)

- Redibujando la topología:



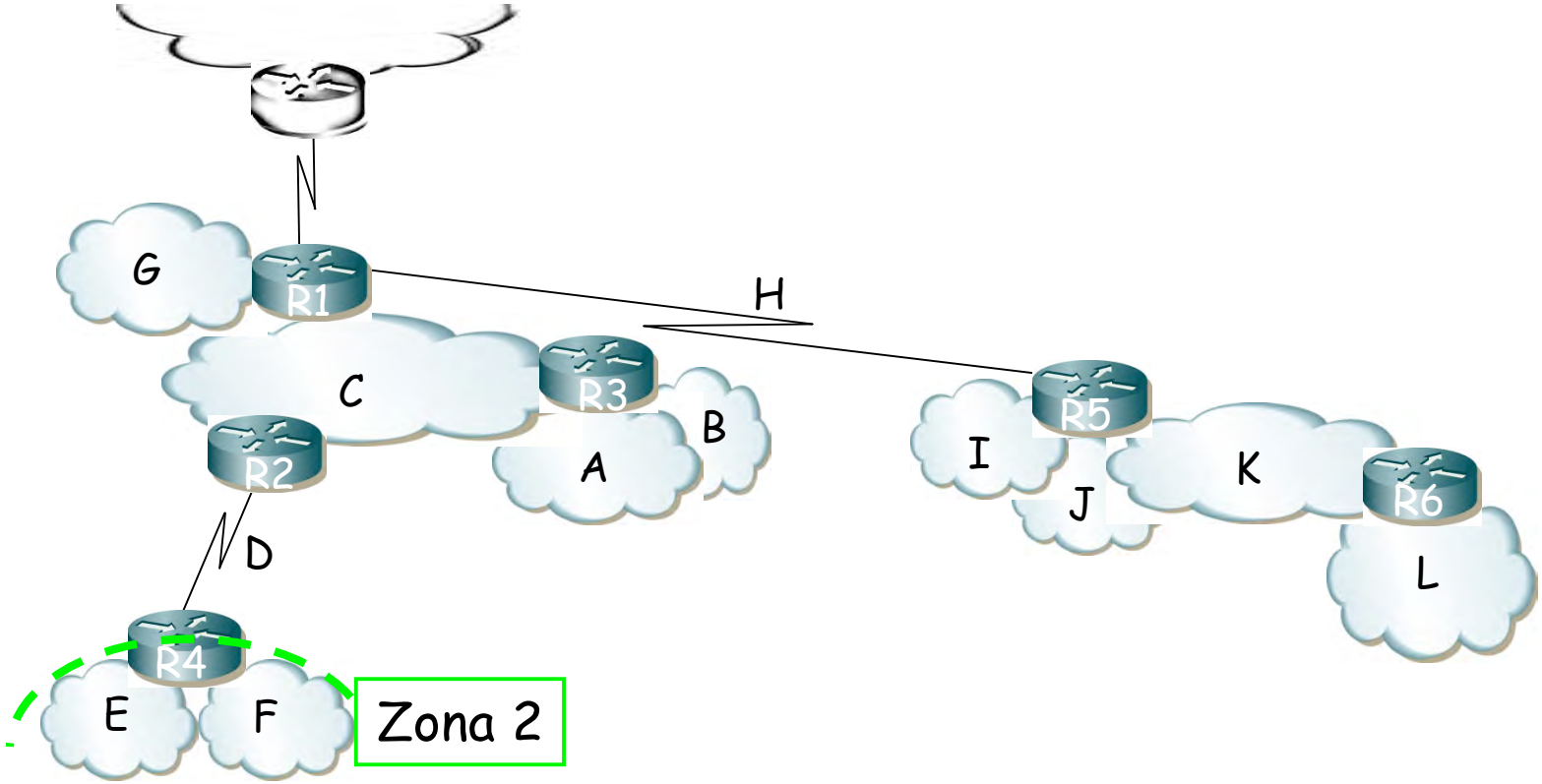
Ejemplo (4)

A	192.168.3	.	[000]	[0]	[0000]	= 192.168.3.0 /28	Zona 1: 192.168.3.0 /27
B	192.168.3	.	[000]	[1]	[0000]	= 192.168.3.16 /28	



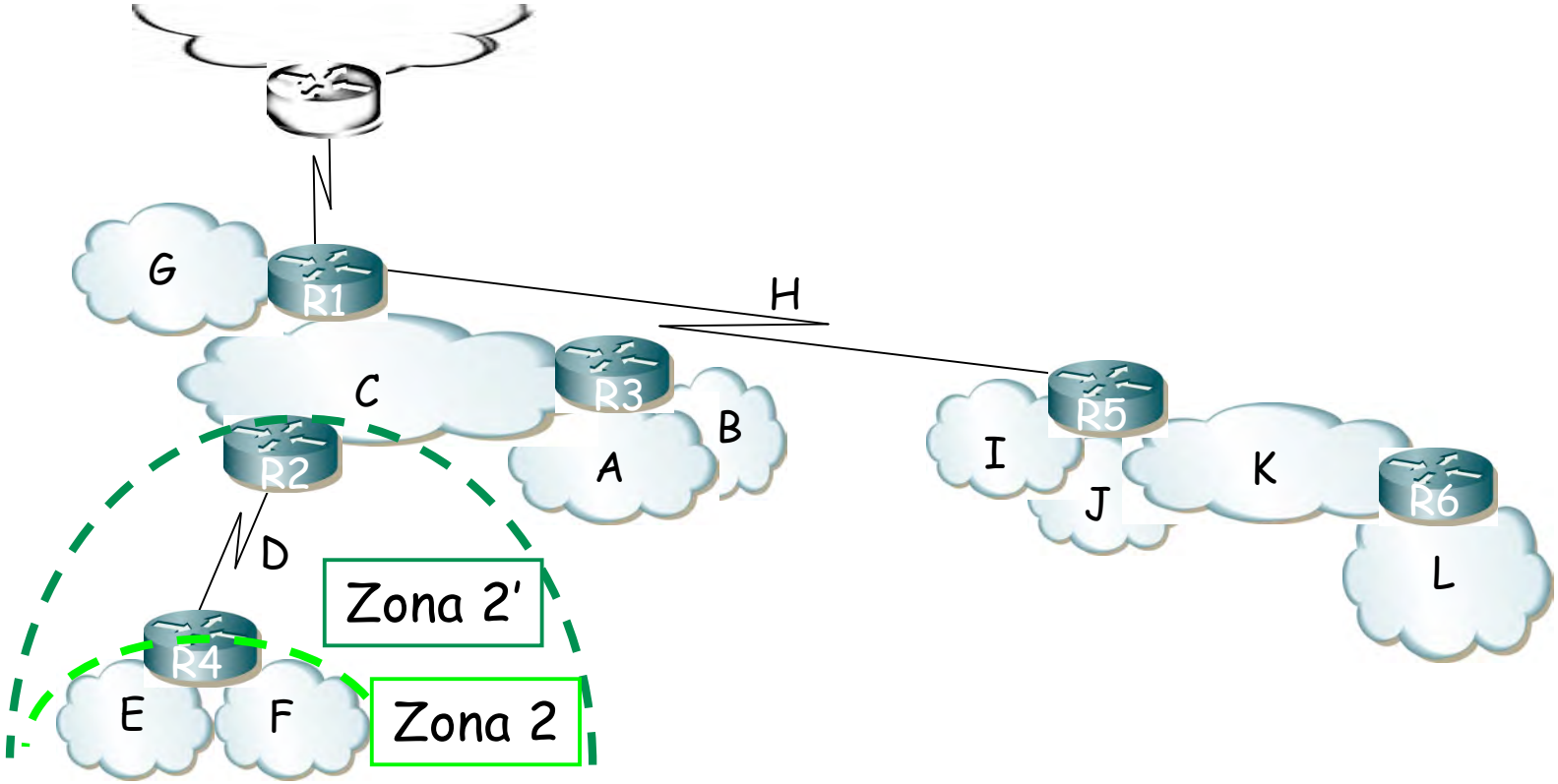
Ejemplo (4)

E	192.168.3	.	[010]	[0]	[0000]	= 192.168.3.64 /28	Zona 2: 192.168.3.64 /27
F	192.168.3	.	[010]	[1]	[0000]	= 192.168.3.80 /28	



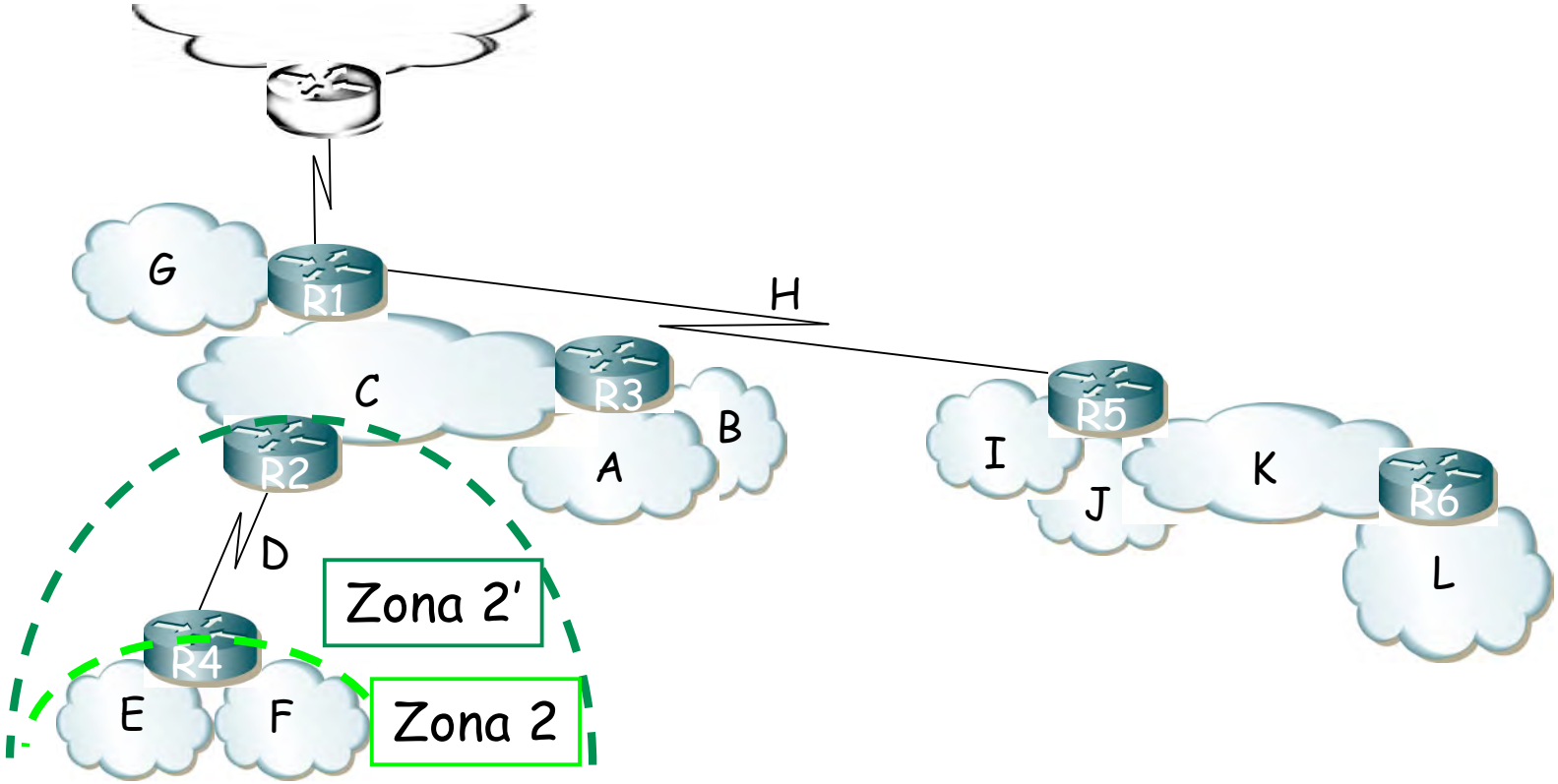
Ejemplo (4)

Zona 2 | 192.168.3 | . | [010] | [00000] | = 192.168.3.64 /27



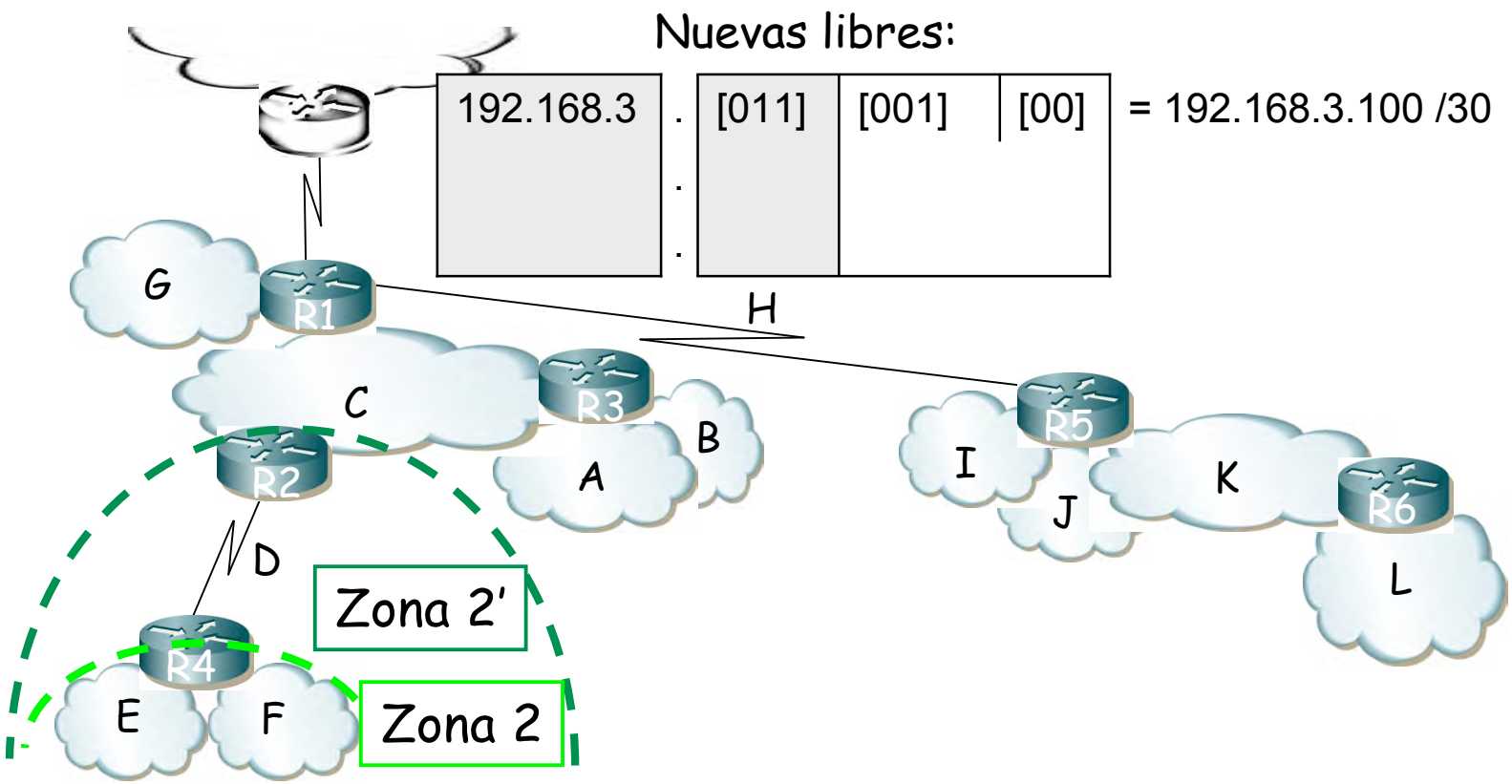
Ejemplo (4)

Zona 2	192.168.3	.	[010]	[00000]	= 192.168.3.64 /27
D	192.168.3	.	[011]	[000] [00]	= 192.168.3.96 /30



Ejemplo (4)

Zona 2	192.168.3	.	[010]	[00000]	= 192.168.3.64 /27
D	192.168.3	.	[011]	[000] [00]	= 192.168.3.96 /30

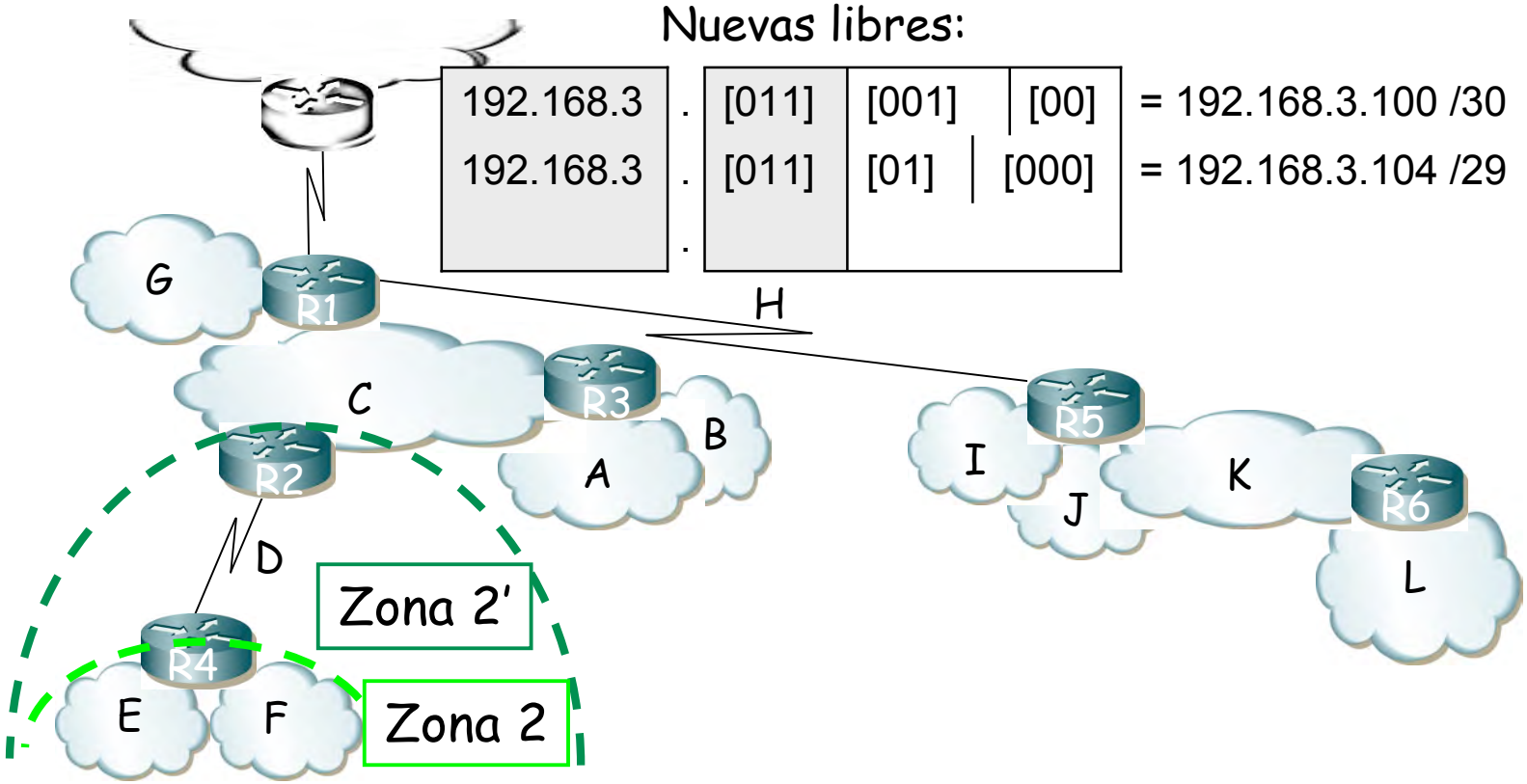


Ejemplo (4)

Zona 2	192.168.3	.	[010]	[00000]	= 192.168.3.64 /27
D	192.168.3	.	[011]	[000] [00]	= 192.168.3.96 /30

Nuevas libres:

192.168.3	.	[011]	[001] [00]	= 192.168.3.100 /30
192.168.3	.	[011]	[01] [000]	= 192.168.3.104 /29
	.			

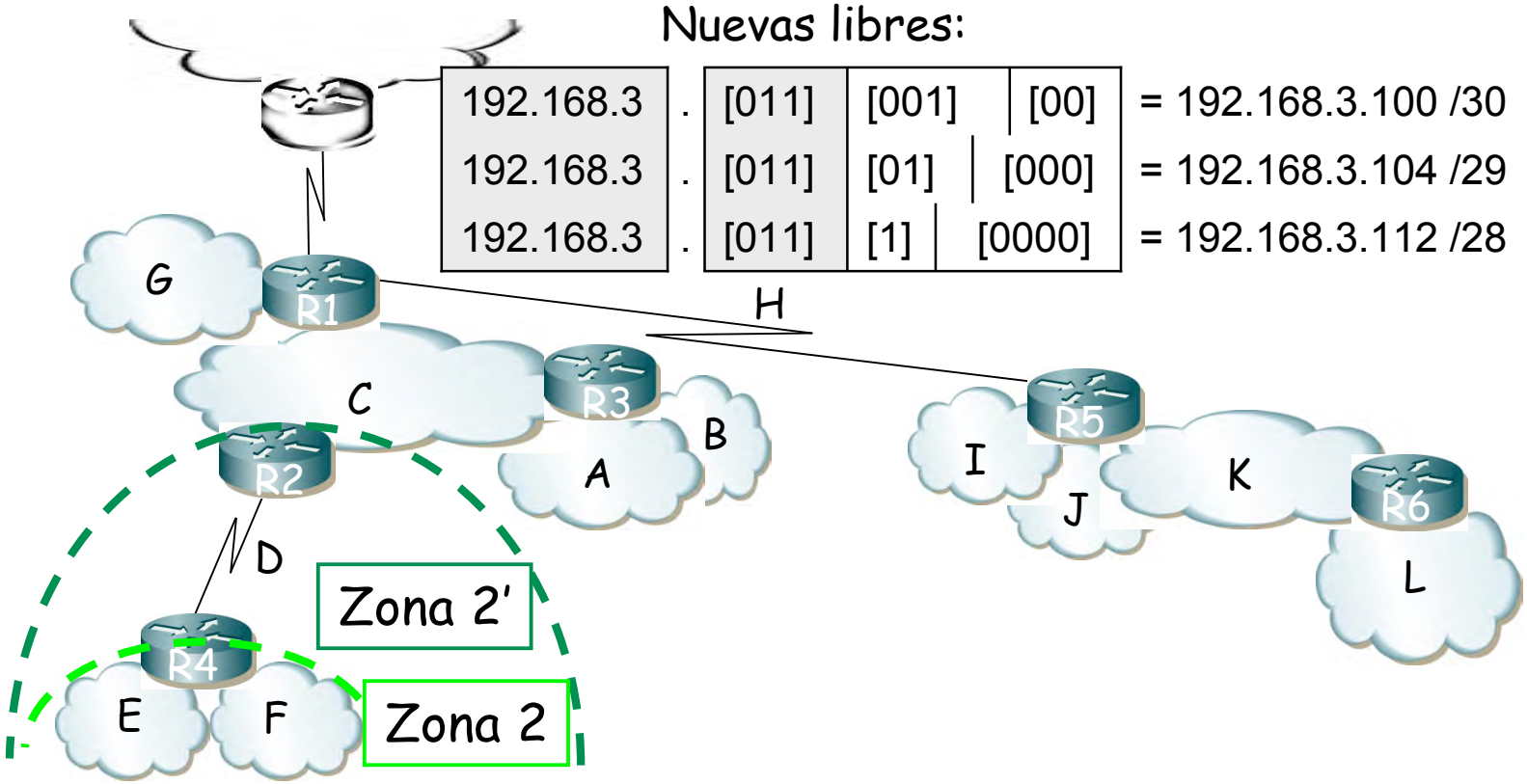


Ejemplo (4)

Zona 2	192.168.3	.	[010]	[00000]	= 192.168.3.64 /27
D	192.168.3	.	[011]	[000] [00]	= 192.168.3.96 /30

Nuevas libres:

192.168.3	.	[011]	[001] [00]	= 192.168.3.100 /30
192.168.3	.	[011]	[01] [000]	= 192.168.3.104 /29
192.168.3	.	[011]	[1] [0000]	= 192.168.3.112 /28



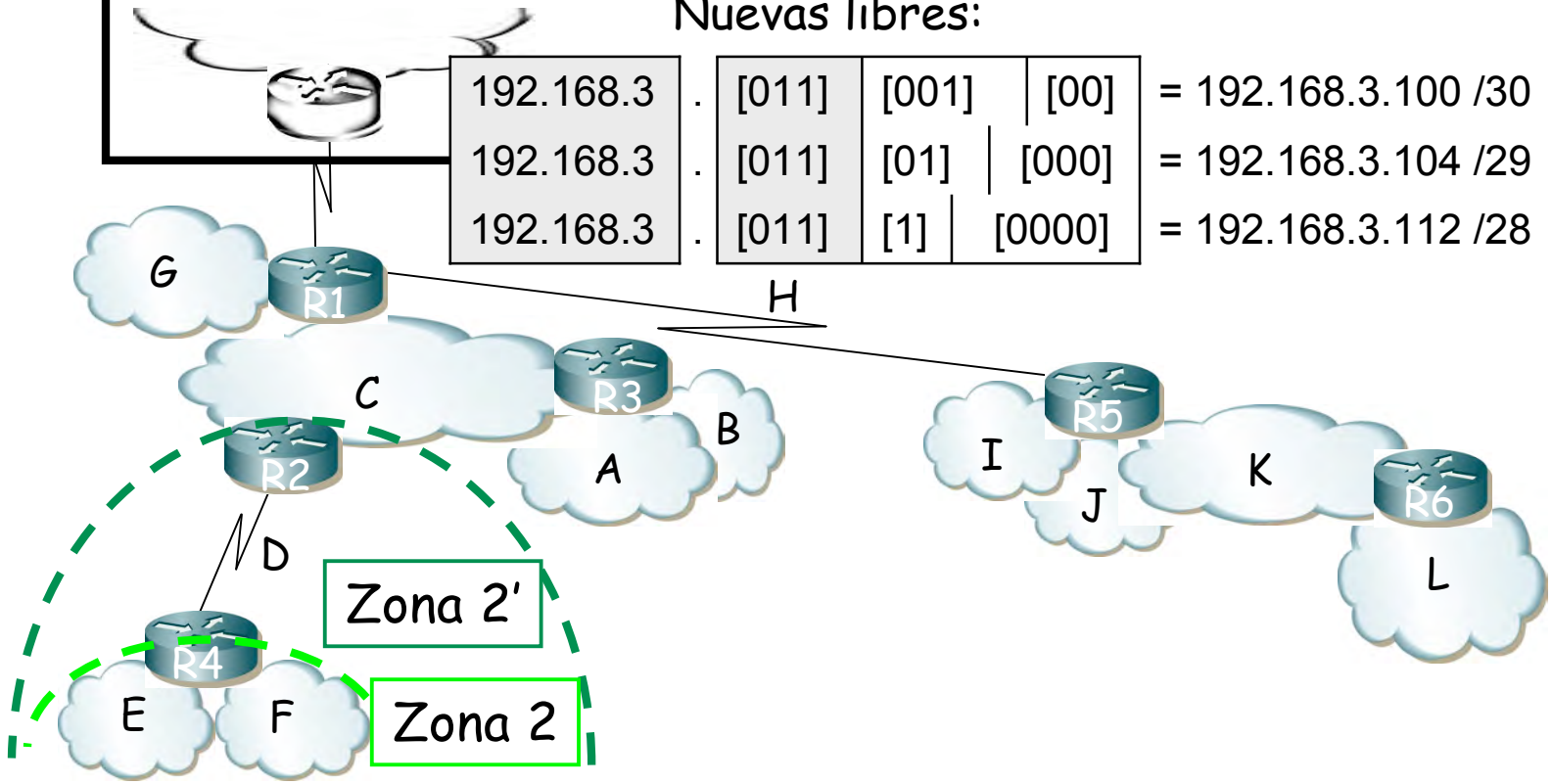
Ejemplo (4)

Zona 2	192.168.3	.	[010]	[00000]	= 192.168.3.64 /27
D	192.168.3	.	[011]	[000] [00]	= 192.168.3.96 /30

Zona 2'	192.168.3	.	[01]	[0000] [00]	= 192.168.3.64 /26

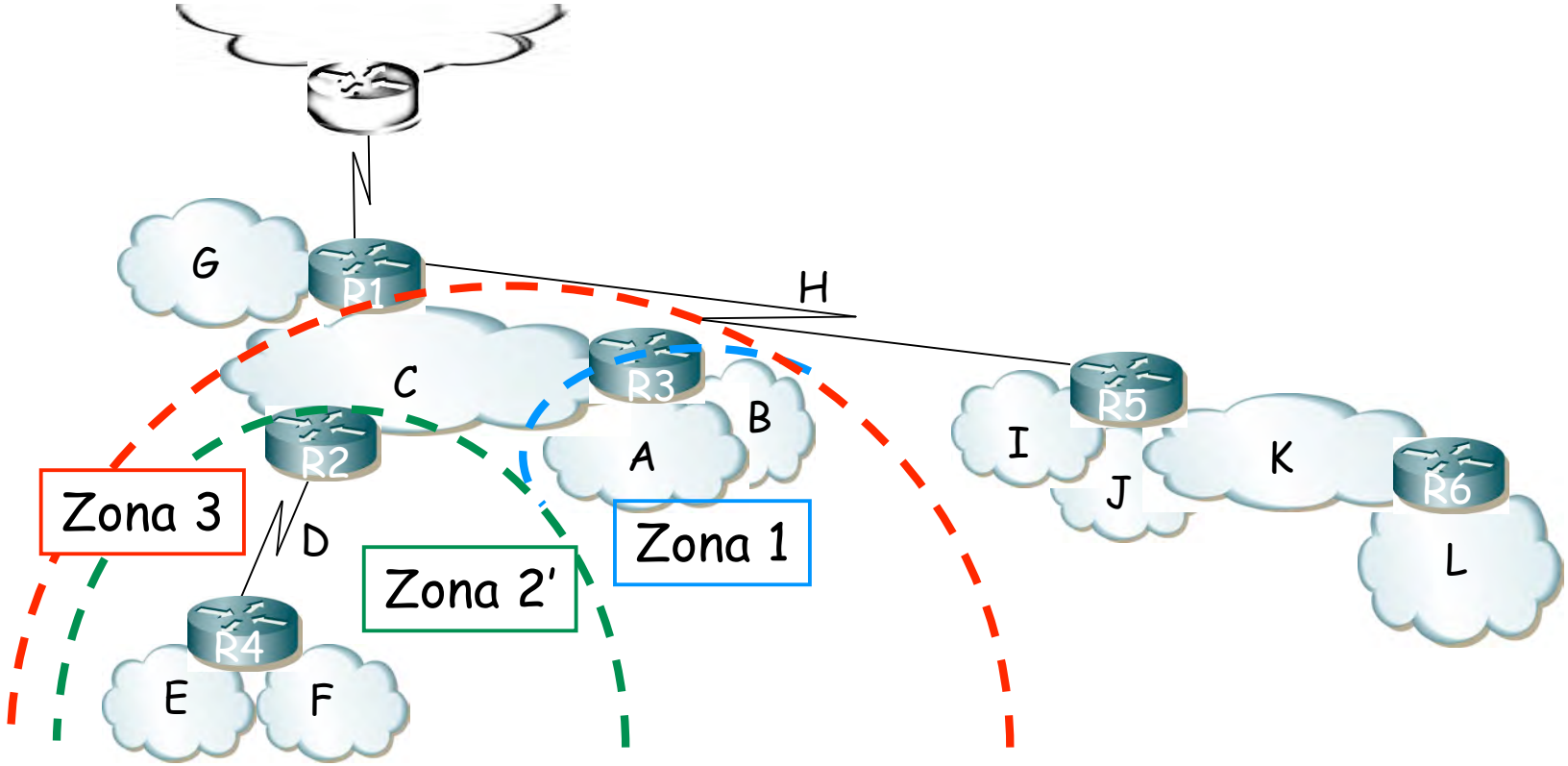
Nuevas libres:

192.168.3	.	[011]	[001] [00]	= 192.168.3.100 /30
192.168.3	.	[011]	[01] [000]	= 192.168.3.104 /29
192.168.3	.	[011]	[1] [0000]	= 192.168.3.112 /28



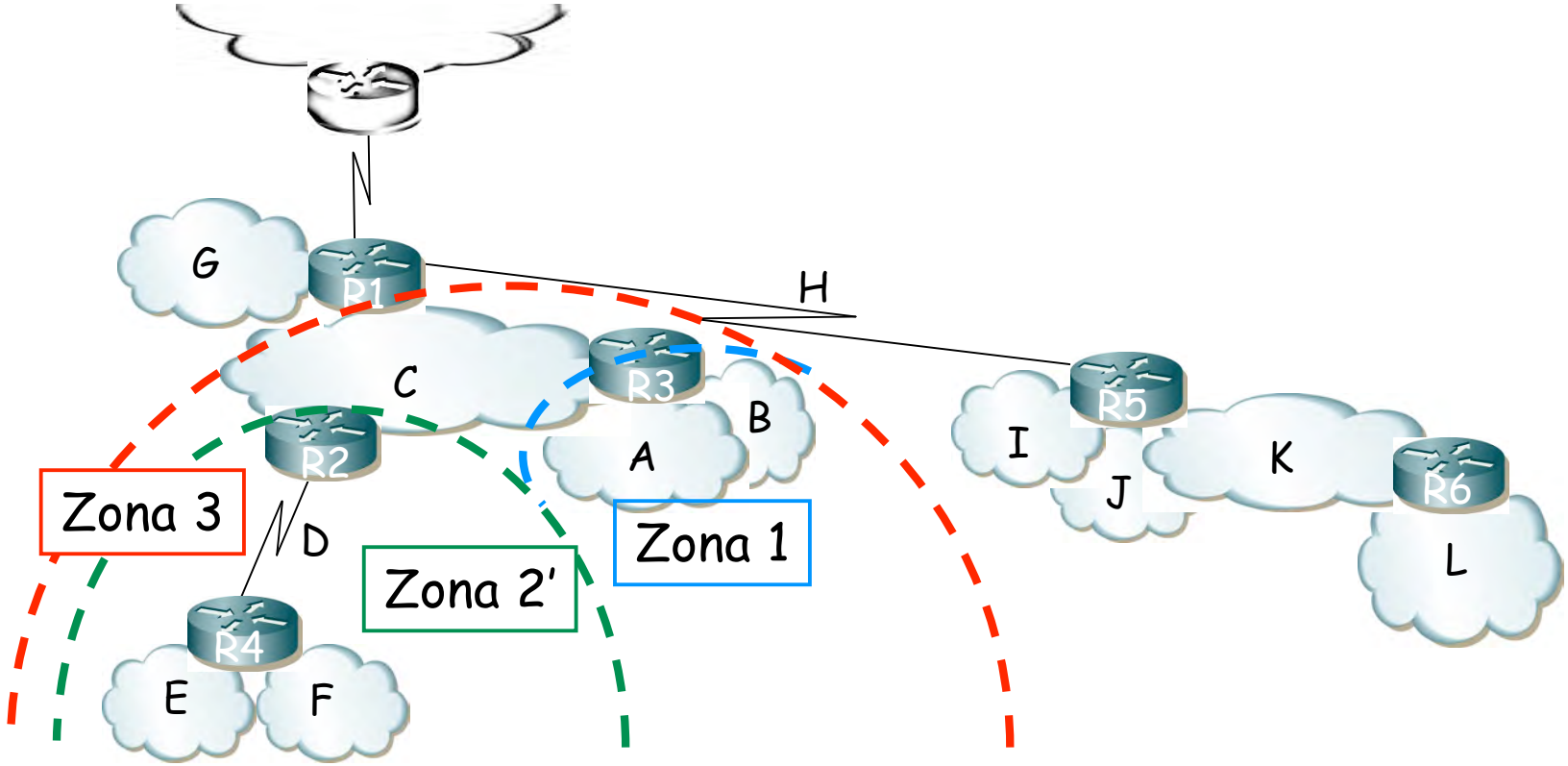
Ejemplo (4)

Zona 1	192.168.3	.	[000]	[00000]	= 192.168.3.0 /27
Zona 2'	192.168.3	.	[01]	[000000]	= 192.168.3.64 /26



Ejemplo (4)

Zona 1	192.168.3	.	[000]	[00000]	= 192.168.3.0 /27
Zona 2'	192.168.3	.	[01]	[000000]	= 192.168.3.64 /26
C	192.168.3	.	[001]	[0] [0000]	= 192.168.3.32 /28



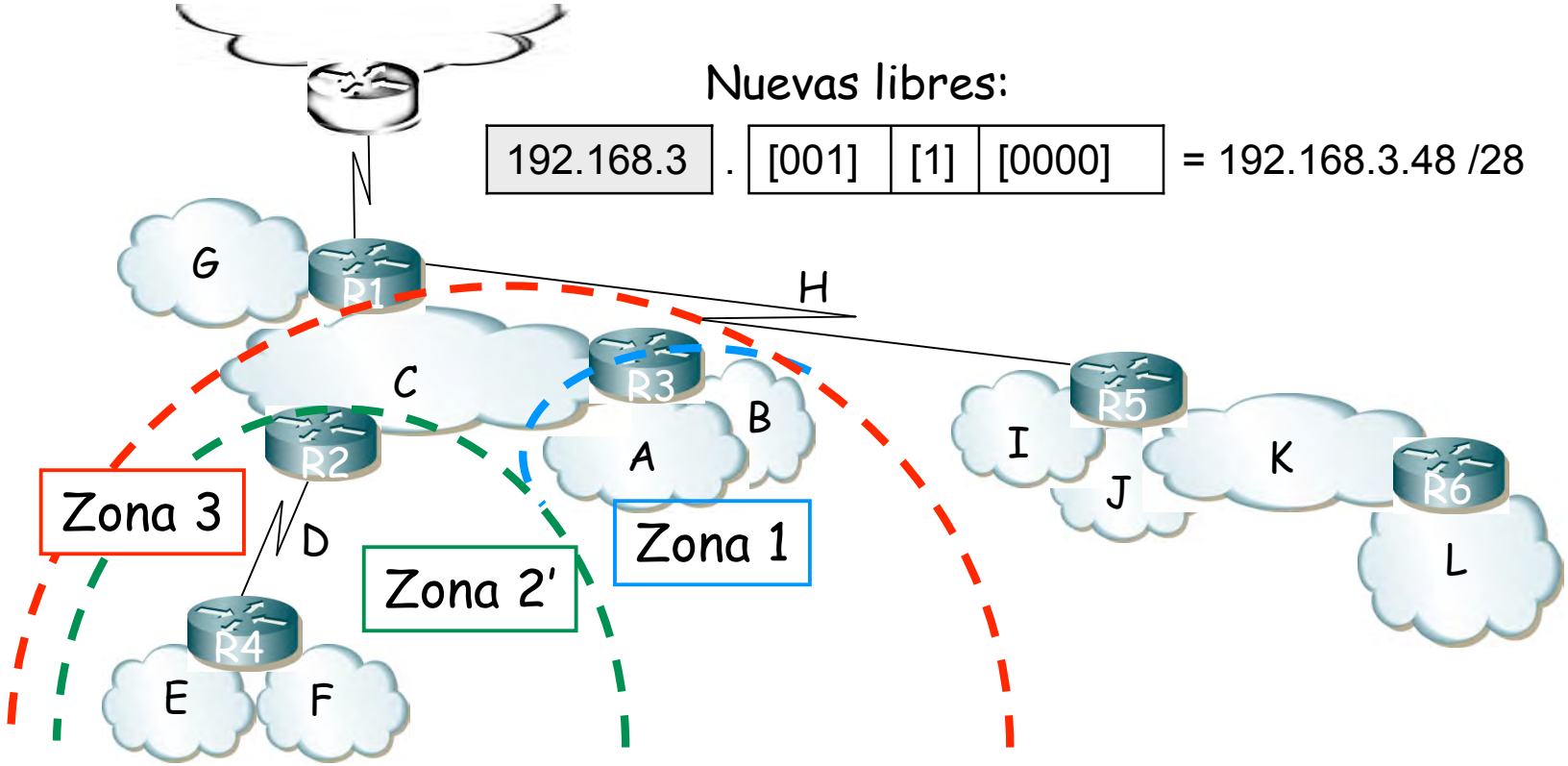
Ejemplo (4)

Zona 1	192.168.3	.	[000]	[00000]	= 192.168.3.0 /27
Zona 2'	192.168.3	.	[01]	[000000]	= 192.168.3.64 /26
C	192.168.3	.	[001]	[0] [0000]	= 192.168.3.32 /28

Nuevas libres:

192.168.3	.	[001]	[1]	[0000]

= 192.168.3.48 /28



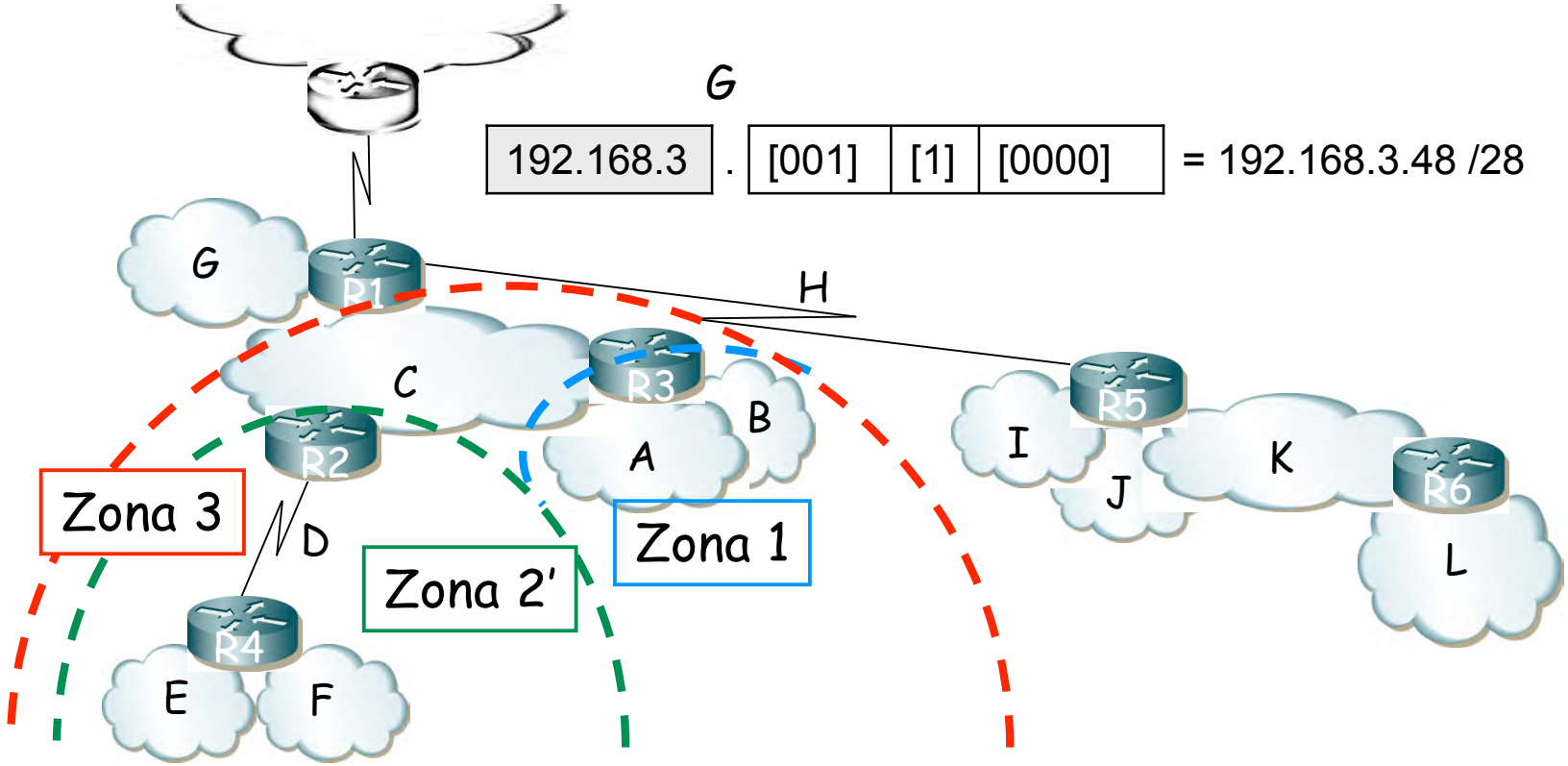
Ejemplo (4)

Zona 1	192.168.3	.	[000]	[00000]	= 192.168.3.0 /27
Zona 2'	192.168.3	.	[01]	[000000]	= 192.168.3.64 /26
C	192.168.3	.	[001]	[0] [0000]	= 192.168.3.32 /28

G

192.168.3	.	[001]	[1]	[0000]

= 192.168.3.48 /28



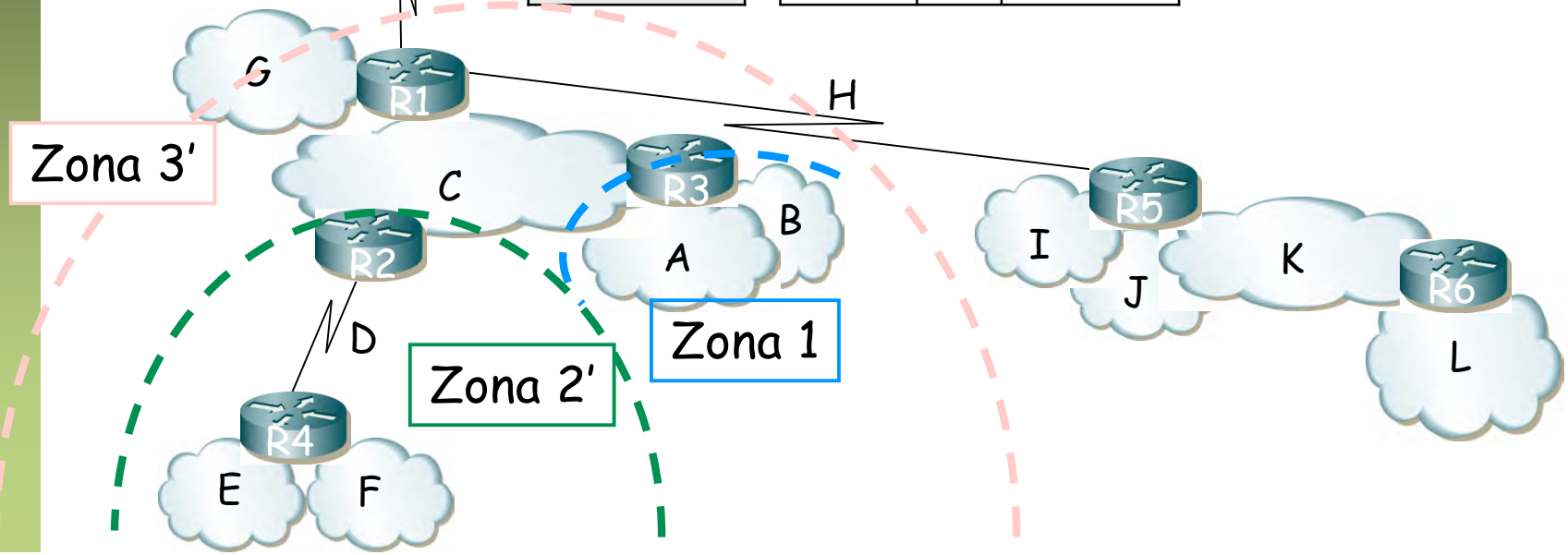
Ejemplo (4)

Zona 1	192.168.3	.	[000]	[00000]	= 192.168.3.0 /27
Zona 2'	192.168.3	.	[01]	[000000]	= 192.168.3.64 /26
C	192.168.3	.	[001]	[0] [0000]	= 192.168.3.32 /28

Zona 3' 192.168.3 . [0] [0000000] = 192.168.3.0 /25

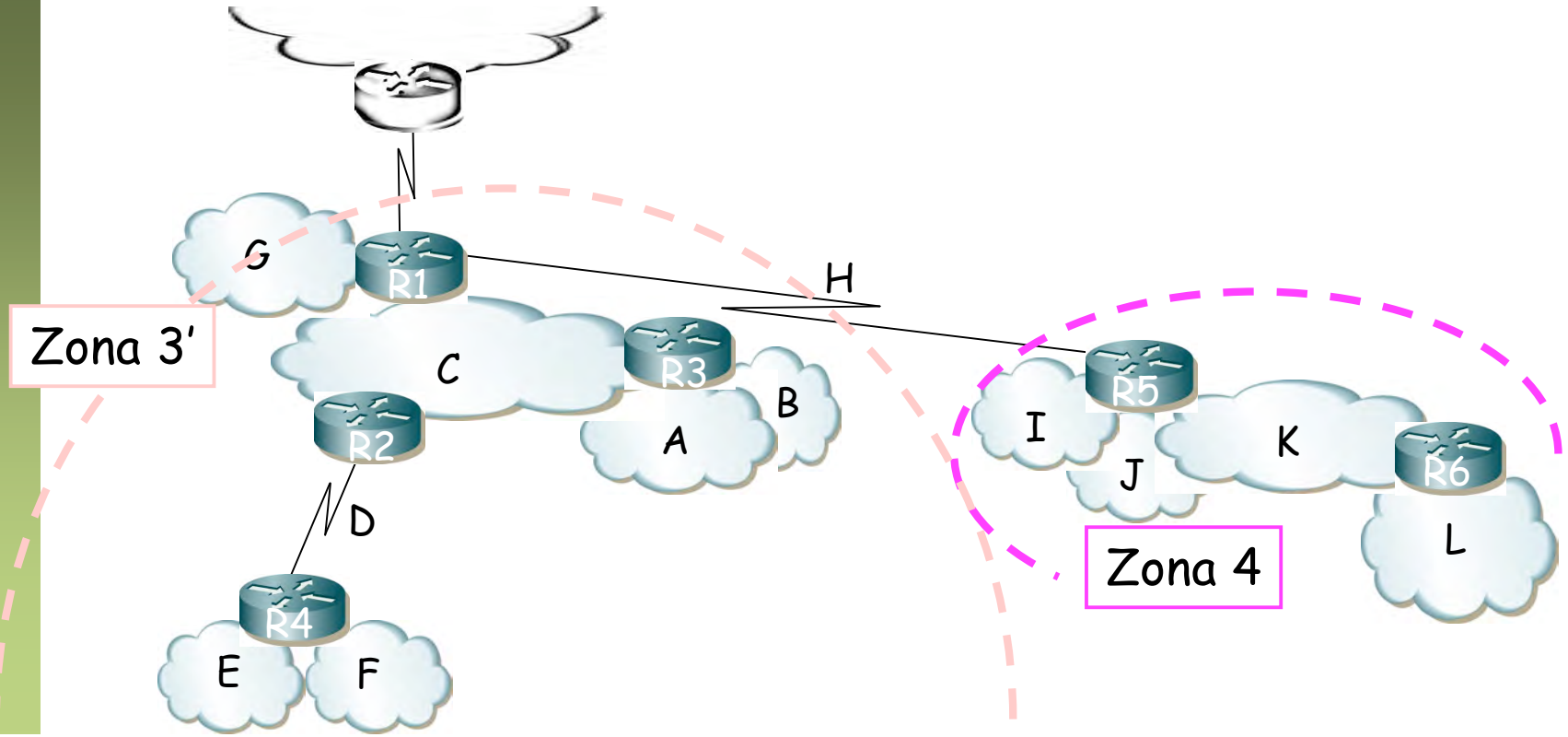
G

192.168.3 . [001] [1] [0000] = 192.168.3.48 /28



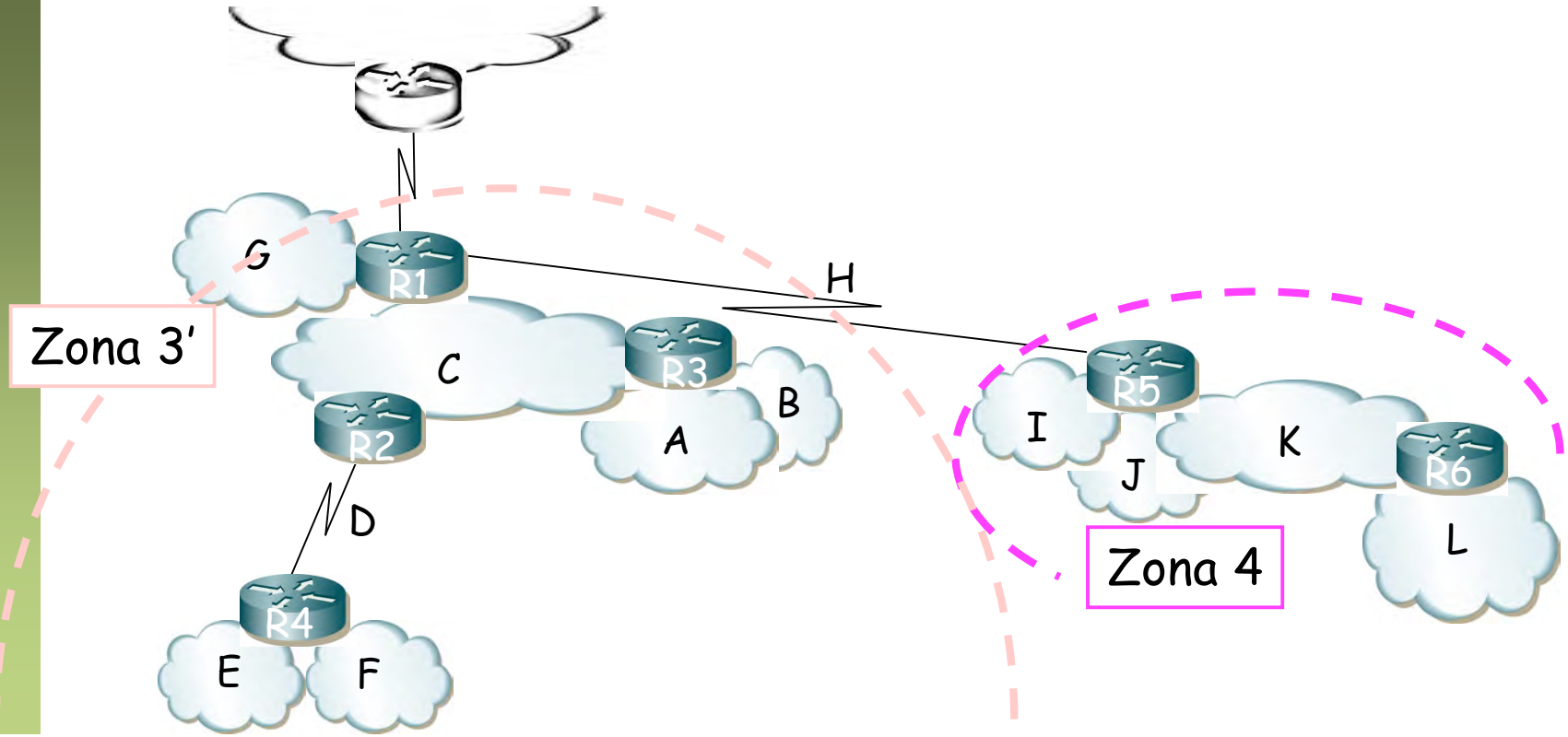
Ejemplo (4)

Zona 3' | 192.168.3 | . | [0] | [0000000] | = 192.168.3.0 /25



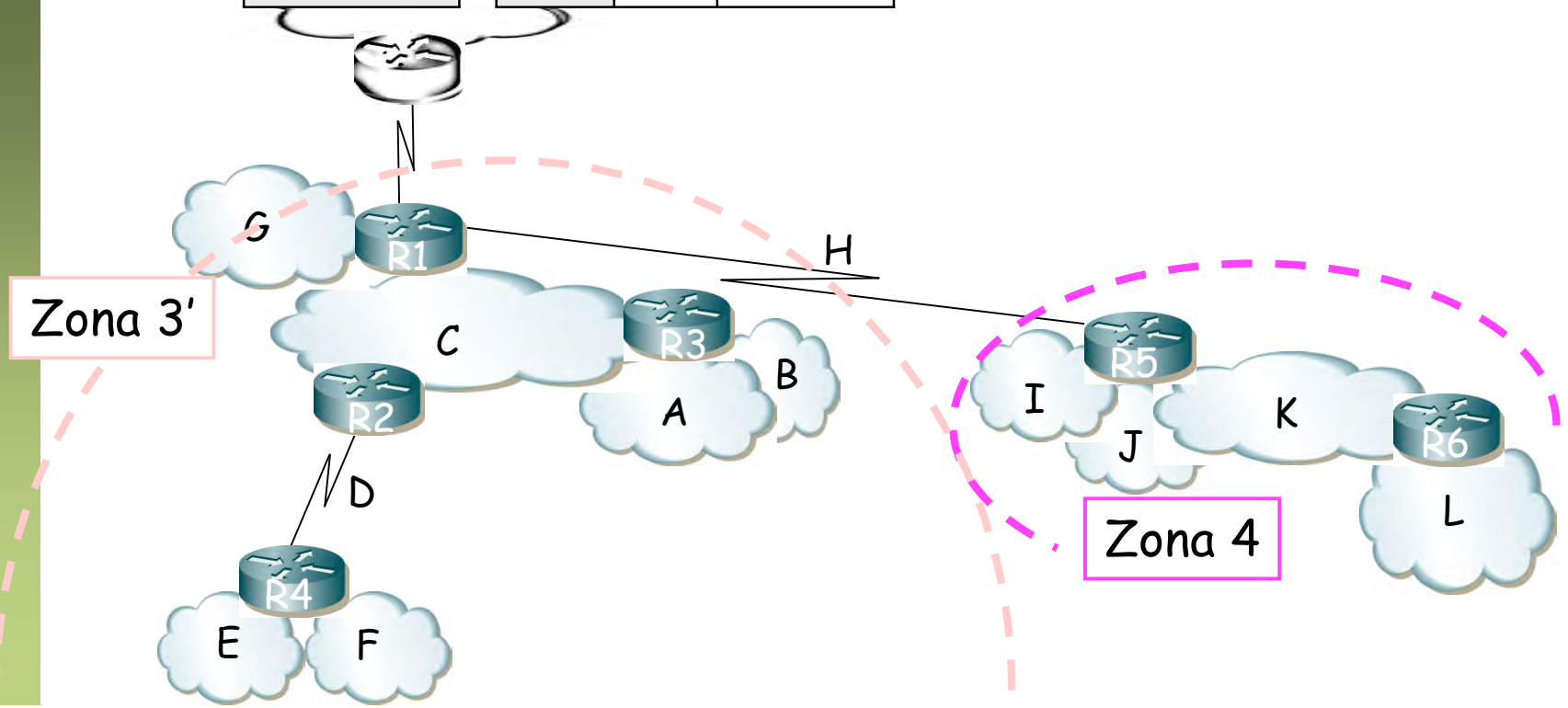
Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26



Ejemplo (4)

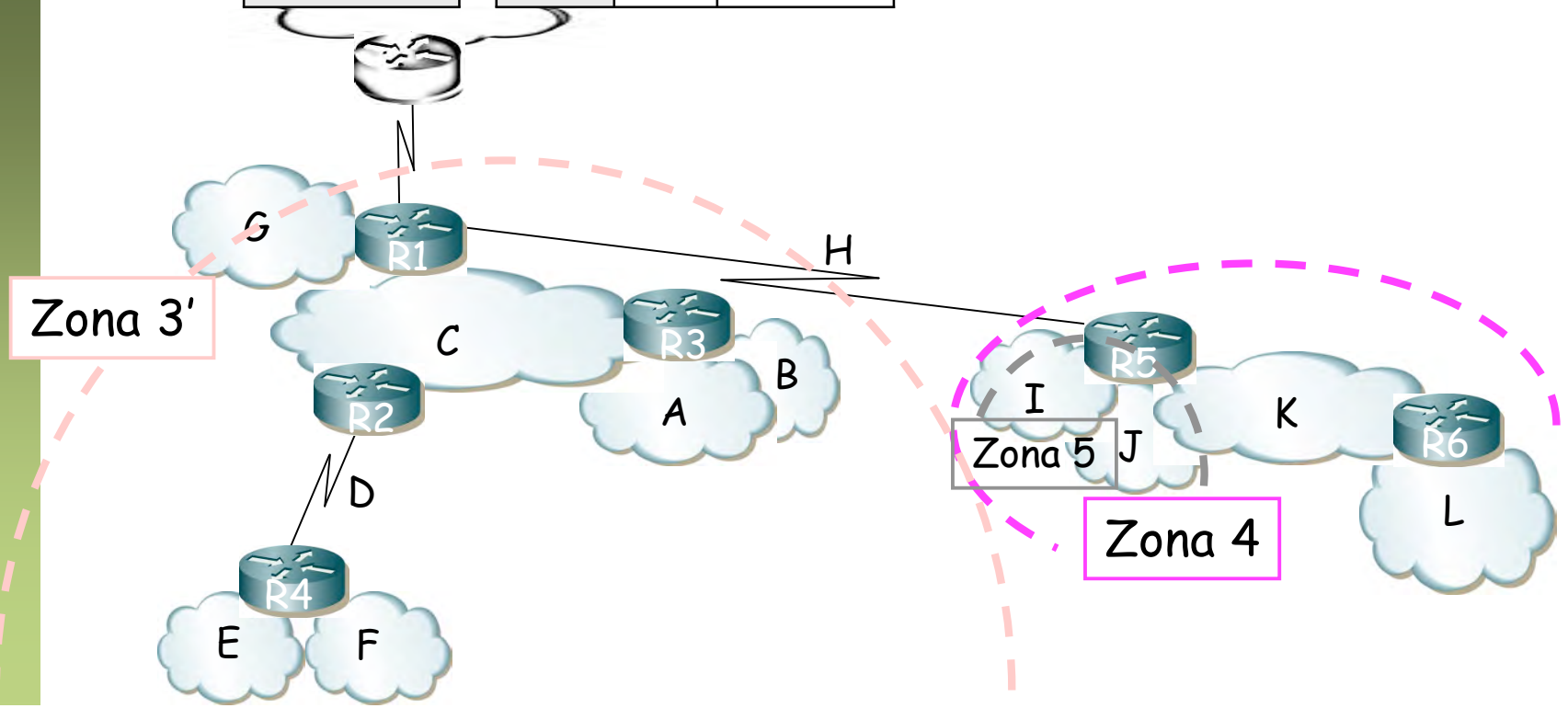
Zona 3'	192.168.3	.	[0]	[0000000]		= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]		= 192.168.3.128 /26
I	192.168.3	.	[10]	[00]	[0000]	= 192.168.3.128 /28
J	192.168.3	.	[10]	[01]	[0000]	= 192.168.3.136 /28
K	192.168.3	.	[10]	[10]	[0000]	= 192.168.3.144 /28
L	192.168.3	.	[10]	[11]	[0000]	= 192.168.3.152 /28



Ejemplo (4)

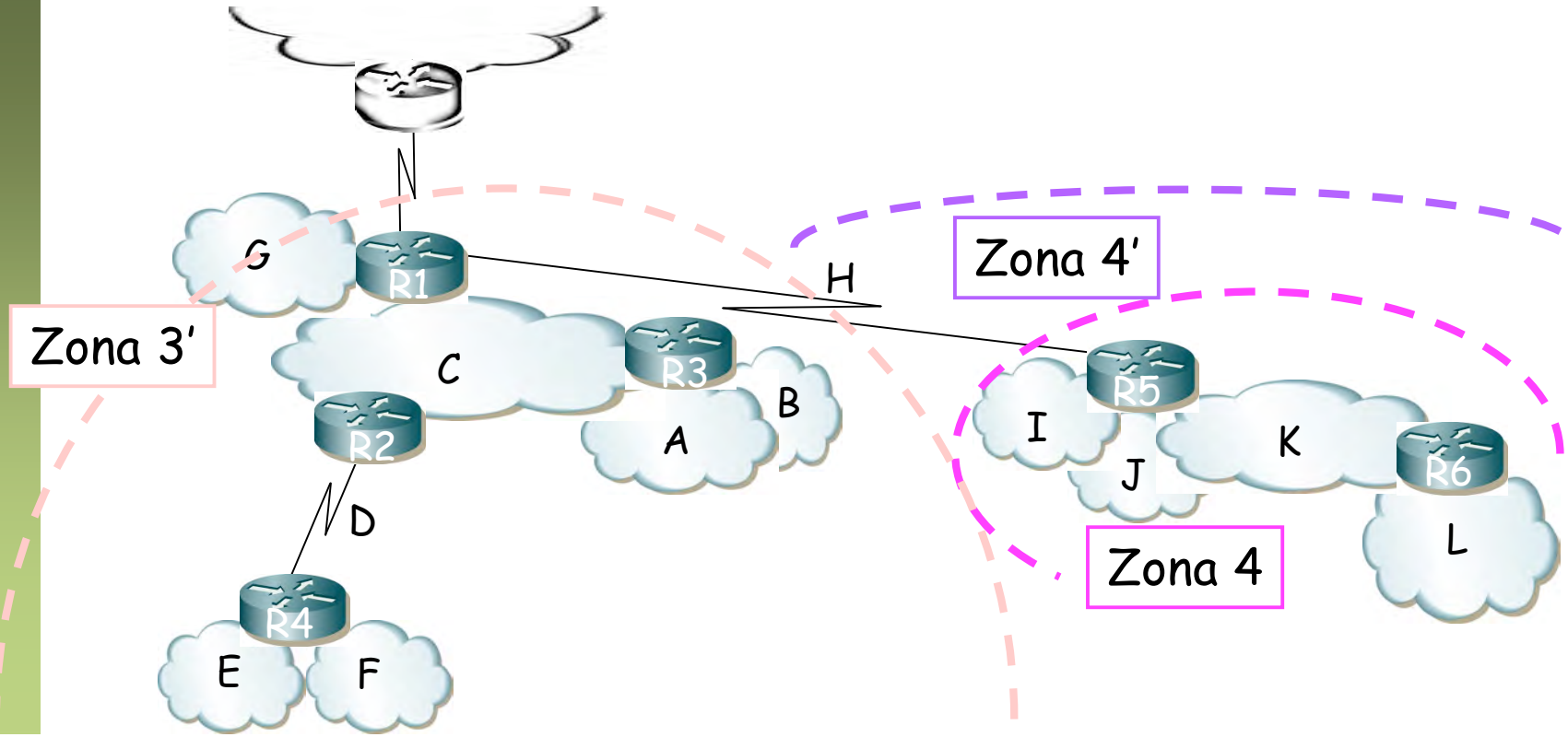
Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0	/25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128	/26
I	192.168.3	.	[10]	[00] [0000]	= 192.168.3.128	/28
J	192.168.3	.	[10]	[01] [0000]	= 192.168.3.136	/28
K	192.168.3	.	[10]	[10] [0000]	= 192.168.3.144	/28
L	192.168.3	.	[10]	[11] [0000]	= 192.168.3.152	/28

Zona 5:
192.168.3.128 /27



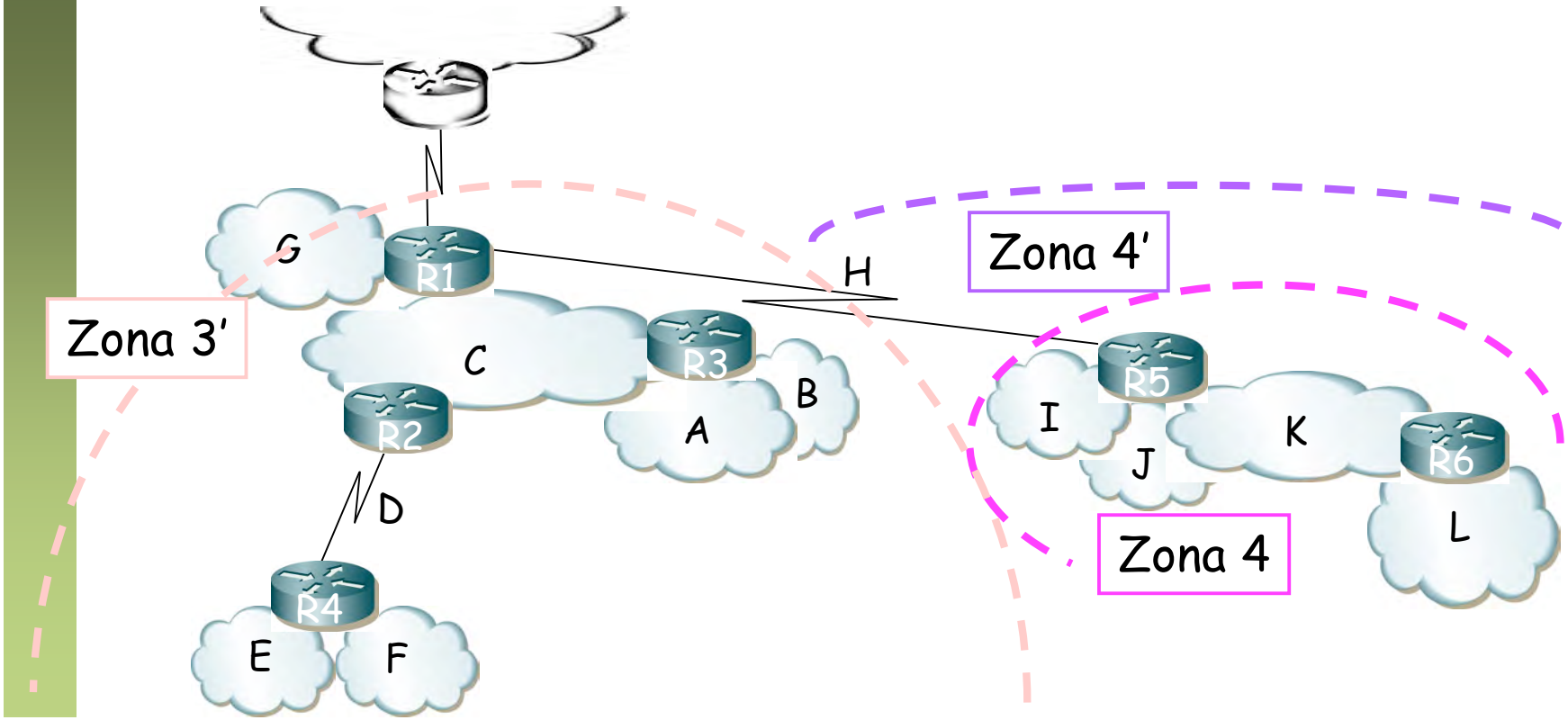
Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26



Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26
H	192.168.3	.	[11]	[0000] [00]	= 192.168.3.192 /30

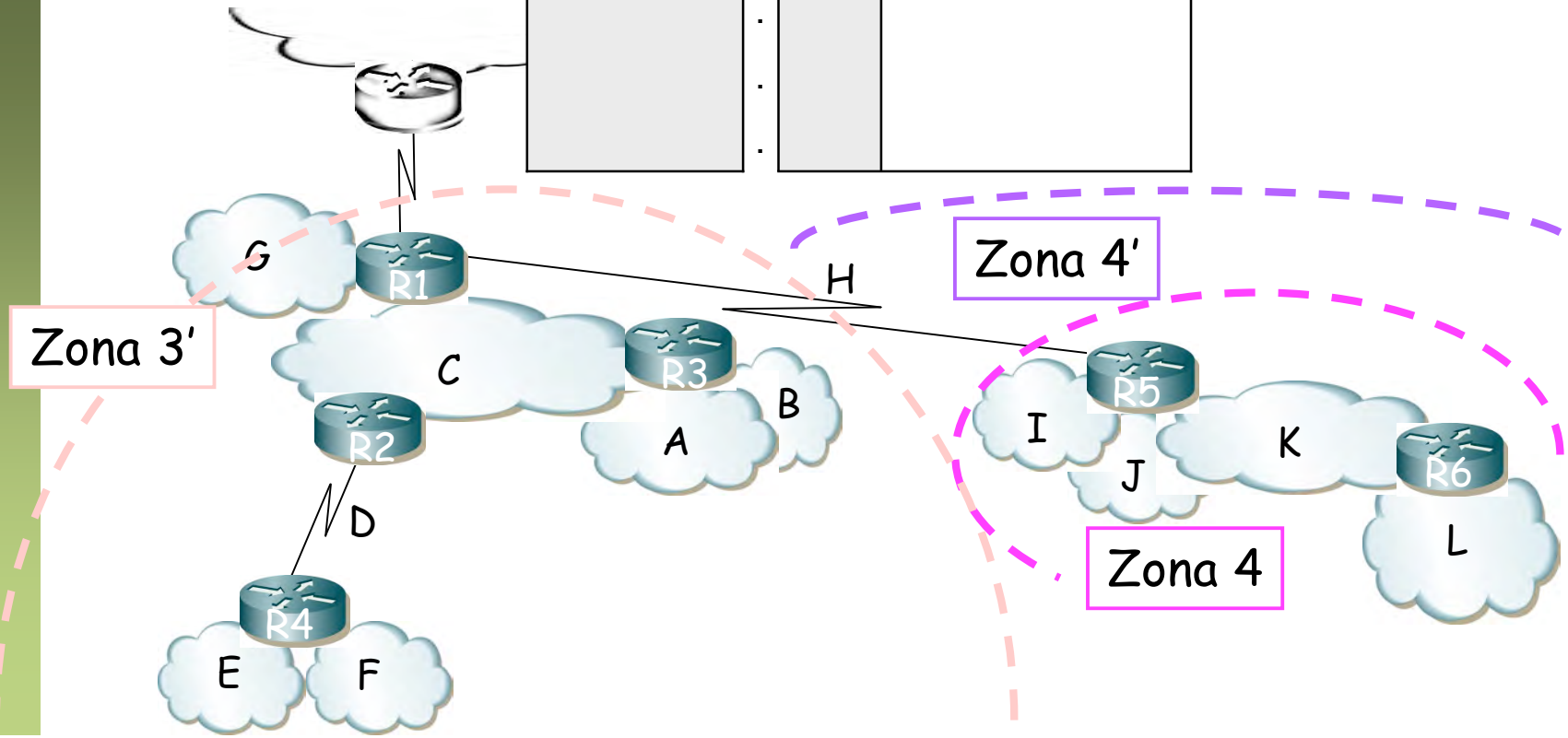


Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26
H	192.168.3	.	[11]	[0000] [00]	= 192.168.3.192 /30

Nuevas libres:

192.168.3	.	[11]	[0001] [00]	= 192.168.3.196 /30

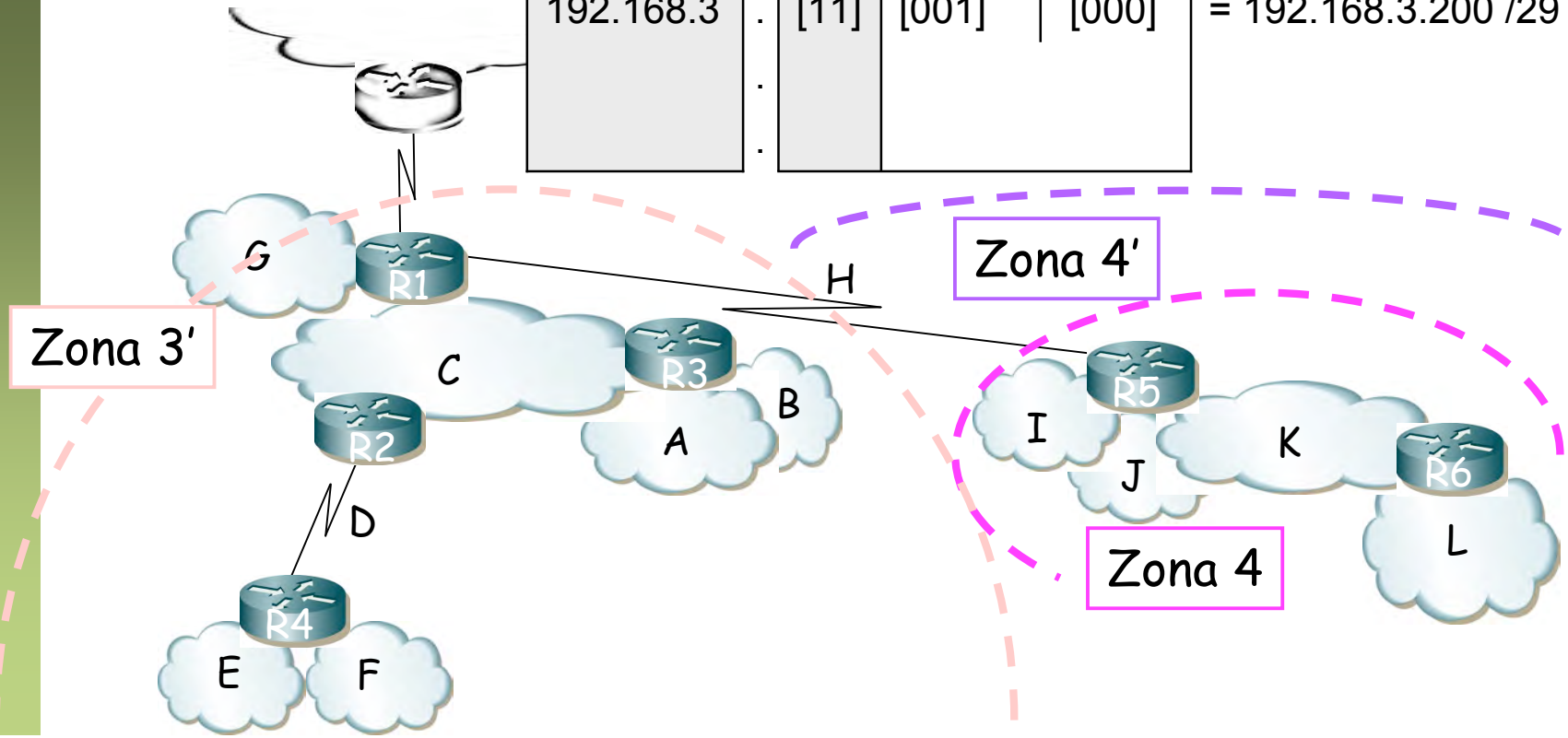


Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26
H	192.168.3	.	[11]	[0000] [00]	= 192.168.3.192 /30

Nuevas libres:

	192.168.3	.	[11]	[0001] [00]	= 192.168.3.196 /30
	192.168.3	.	[11]	[001] [000]	= 192.168.3.200 /29
		.			
		.			

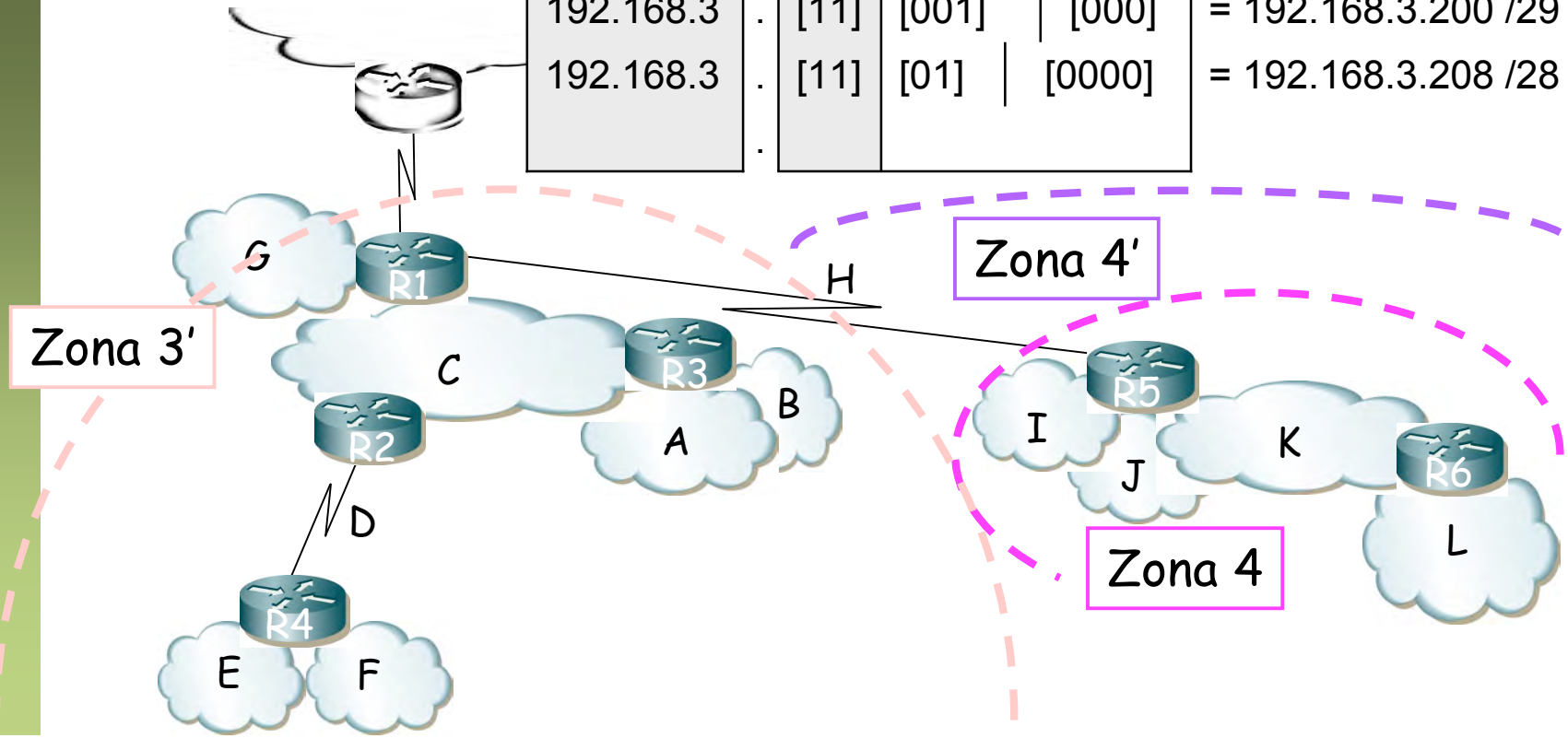


Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26
H	192.168.3	.	[11]	[0000] [00]	= 192.168.3.192 /30

Nuevas libres:

192.168.3	.	[11]	[0001] [00]	= 192.168.3.196 /30
192.168.3	.	[11]	[001] [000]	= 192.168.3.200 /29
192.168.3	.	[11]	[01] [0000]	= 192.168.3.208 /28

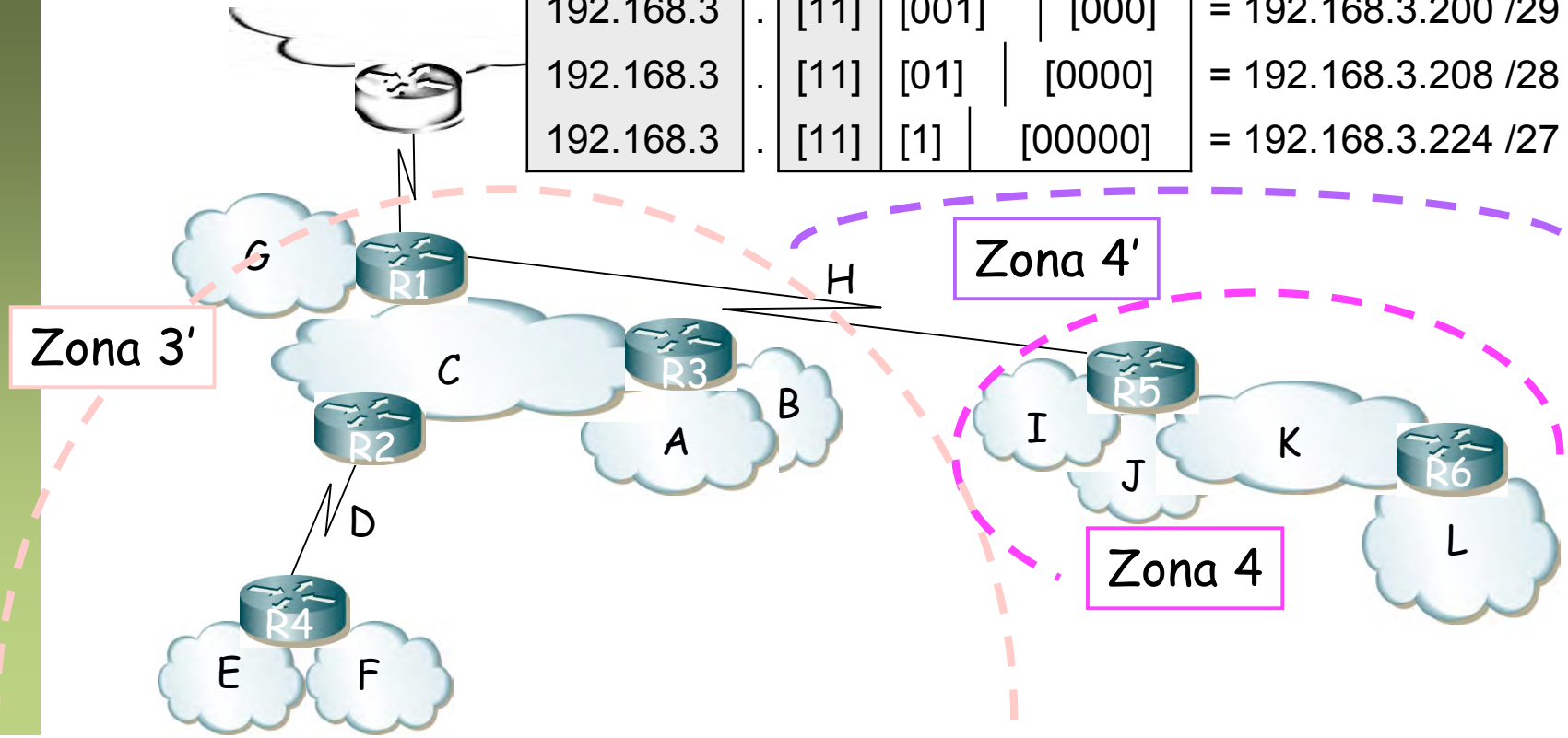


Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26
H	192.168.3	.	[11]	[0000] [00]	= 192.168.3.192 /30

Nuevas libres:

192.168.3	.	[11]	[0001] [00]	= 192.168.3.196 /30
192.168.3	.	[11]	[001] [000]	= 192.168.3.200 /29
192.168.3	.	[11]	[01] [0000]	= 192.168.3.208 /28
192.168.3	.	[11]	[1] [00000]	= 192.168.3.224 /27

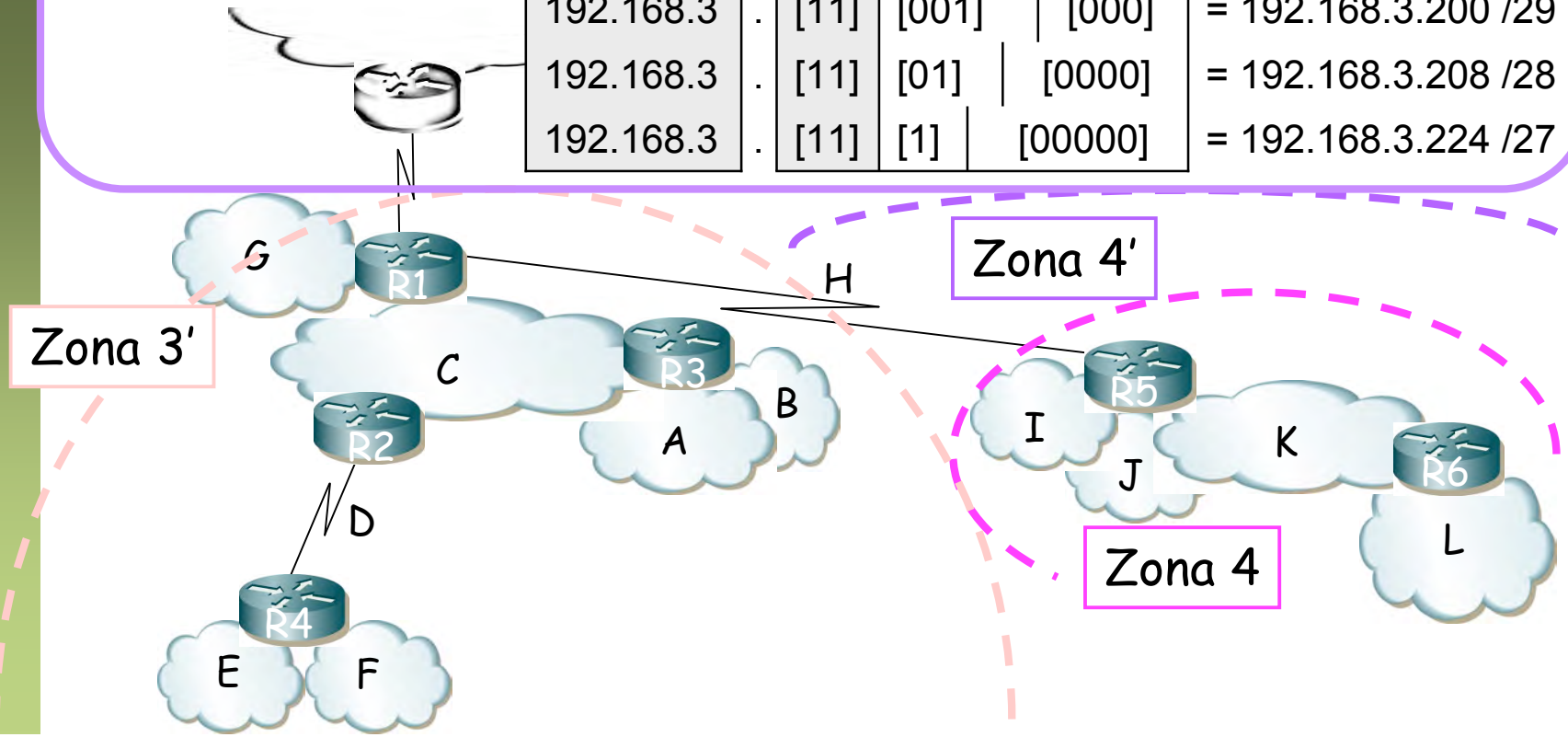


Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4	192.168.3	.	[10]	[000000]	= 192.168.3.128 /26
H	192.168.3	.	[11]	[0000] [00]	= 192.168.3.192 /30

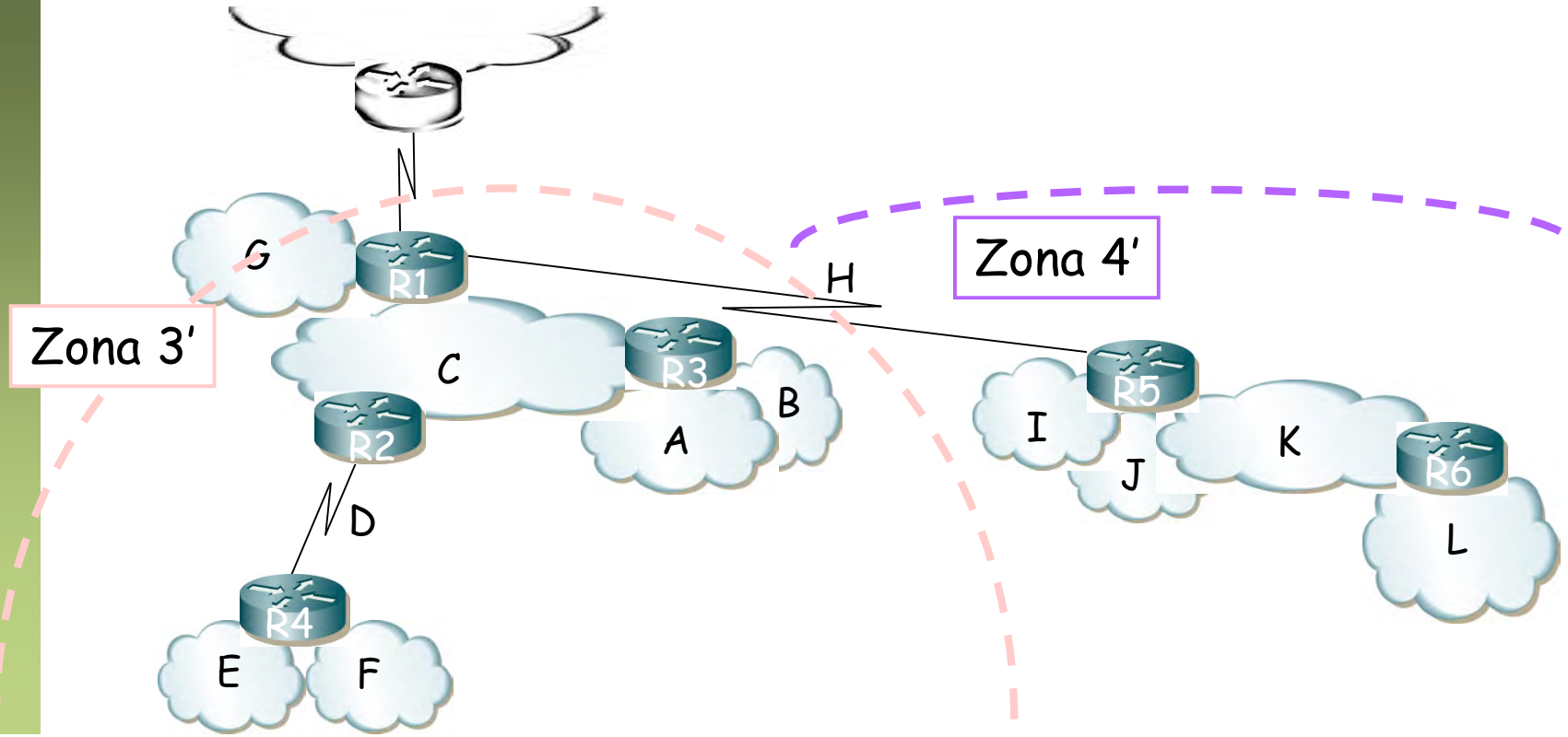
Nuevas libres:

192.168.3	.	[11]	[0001] [00]	= 192.168.3.196 /30
192.168.3	.	[11]	[001] [000]	= 192.168.3.200 /29
192.168.3	.	[11]	[01] [0000]	= 192.168.3.208 /28
192.168.3	.	[11]	[1] [00000]	= 192.168.3.224 /27



Ejemplo (4)

Zona 3'	192.168.3	.	[0]	[0000000]	= 192.168.3.0 /25
Zona 4'	192.168.3	.	[1]	[0000000]	= 192.168.3.128 /25

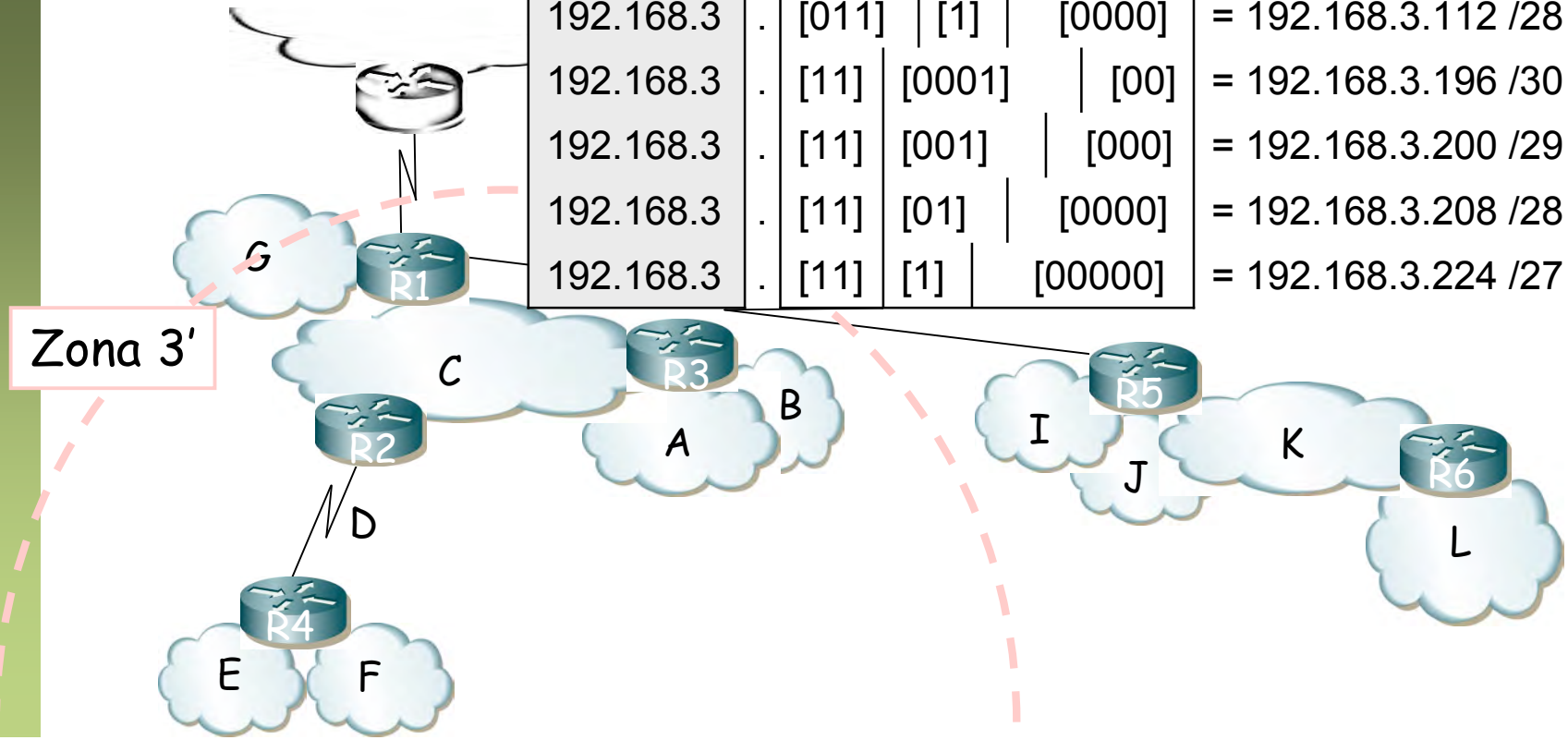


Ejemplo (4)

Zona 3'	192.168.3	[0]	[0000000]	= 192.168.3.0 /25
Zona 4'	192.168.3	[1]	[0000000]	= 192.168.3.128 /25

Libres totales:

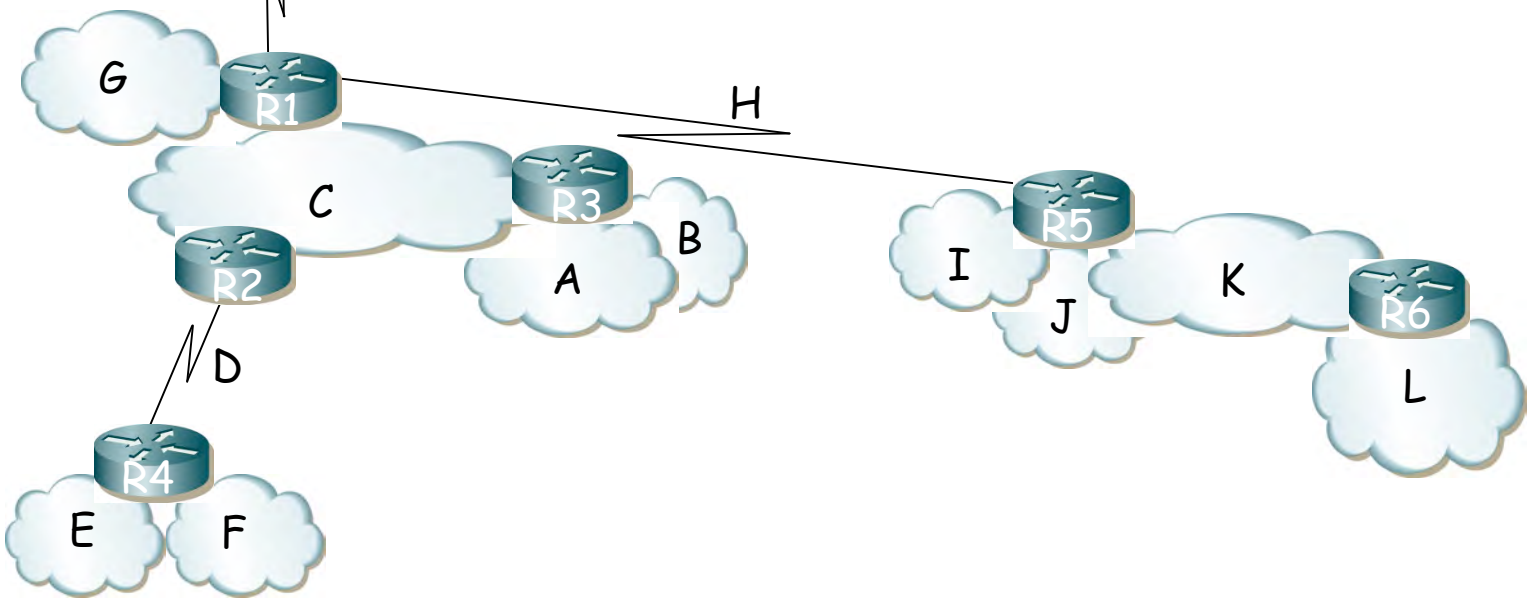
192.168.3	[011]	[001]	[00]	= 192.168.3.100 /30
192.168.3	[011]	[01]	[000]	= 192.168.3.104 /29
192.168.3	[011]	[1]	[0000]	= 192.168.3.112 /28
192.168.3	[11]	[0001]	[00]	= 192.168.3.196 /30
192.168.3	[11]	[001]	[000]	= 192.168.3.200 /29
192.168.3	[11]	[01]	[0000]	= 192.168.3.208 /28
192.168.3	[11]	[1]	[00000]	= 192.168.3.224 /27



Ejemplo (4)

Tabla de rutas de R1:

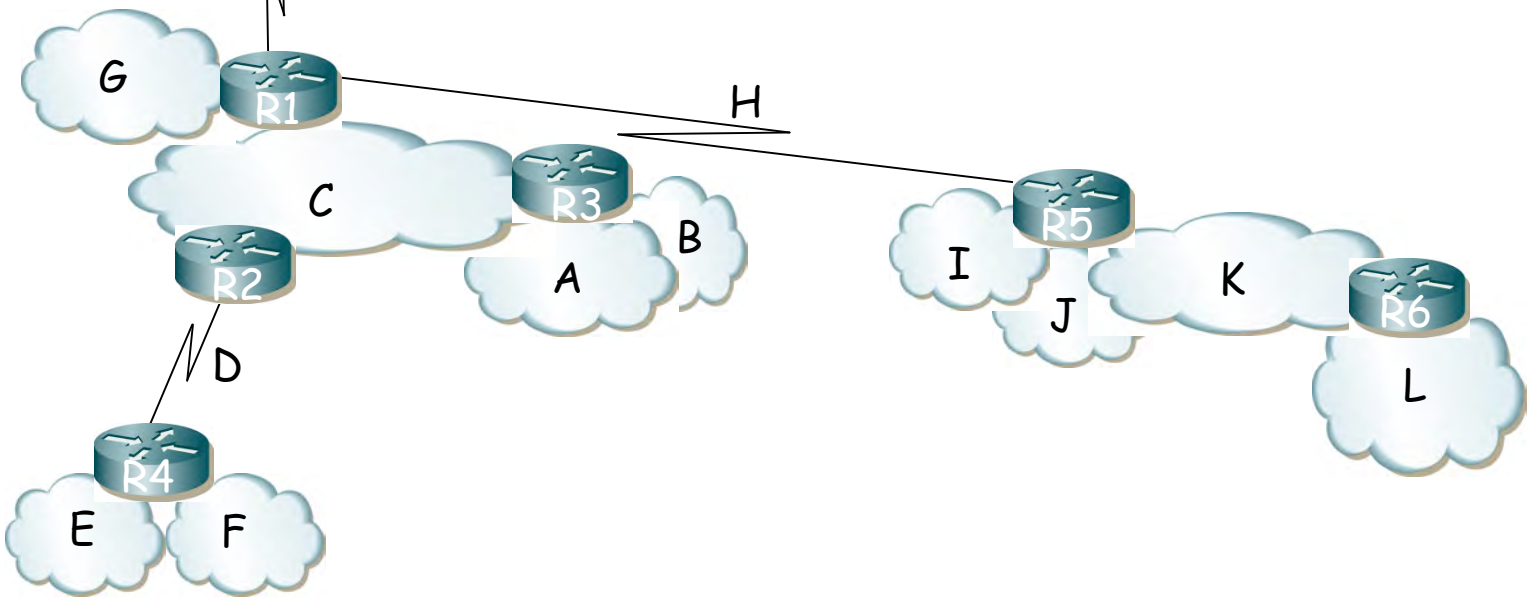
Destino		Next-hop	Interfaz



Ejemplo (4)

Tabla de rutas de R1:

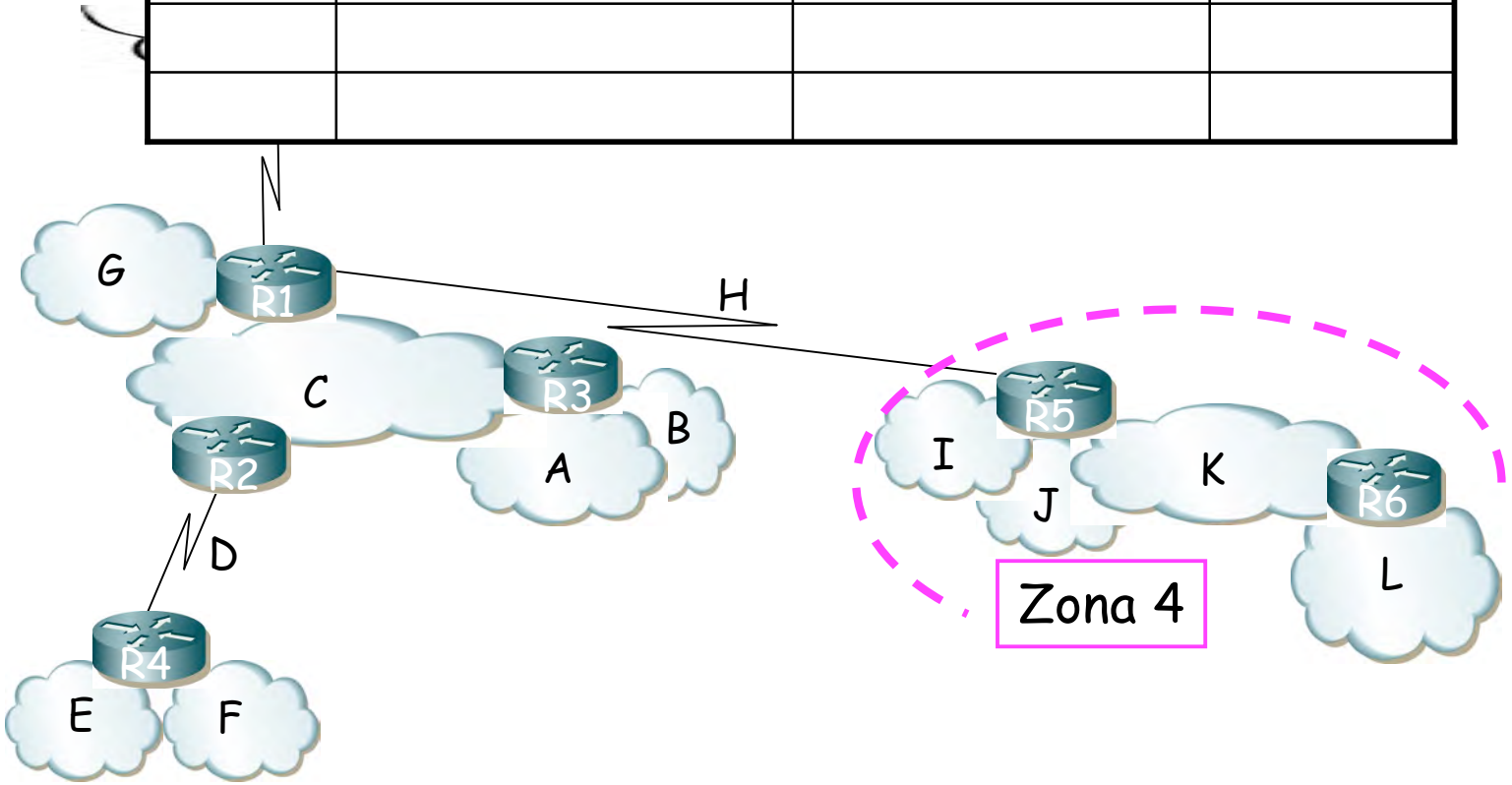
Destino		Next-hop	Interfaz
Red C	192.168.3.32 /28	(dir.connected)	ifR1RedC
Red G	192.168.3.48 /28	(dir.connected)	ifR1RedG
Red H	192.168.3.192 /30	(dir.connected)	ifR1RedH



Ejemplo (4)

Tabla de rutas de R1:

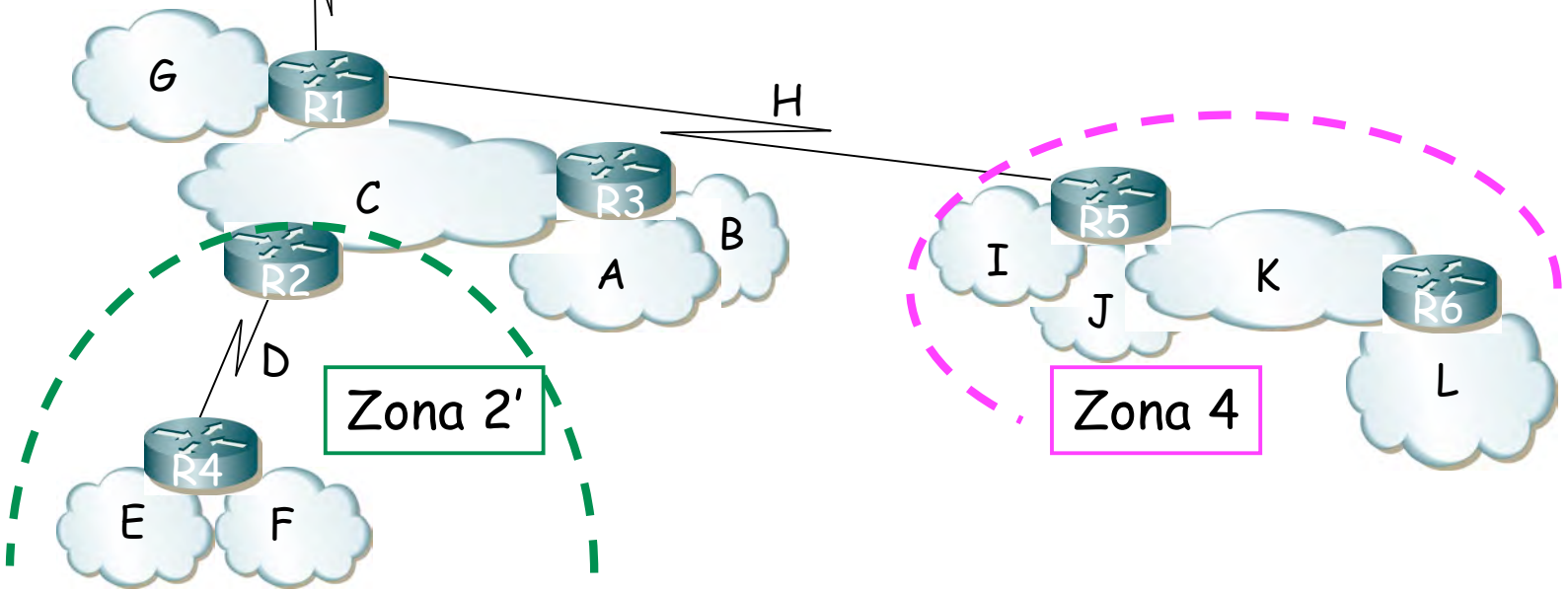
Destino		Next-hop	Interfaz
Red C	192.168.3.32 /28	(dir.connected)	ifR1RedC
Red G	192.168.3.48 /28	(dir.connected)	ifR1RedG
Red H	192.168.3.192 /30	(dir.connected)	ifR1RedH
Zona 4	192.168.3.128 /26	IPR5ifRedH	ifR1RedH



Ejemplo (4)

Tabla de rutas de R1:

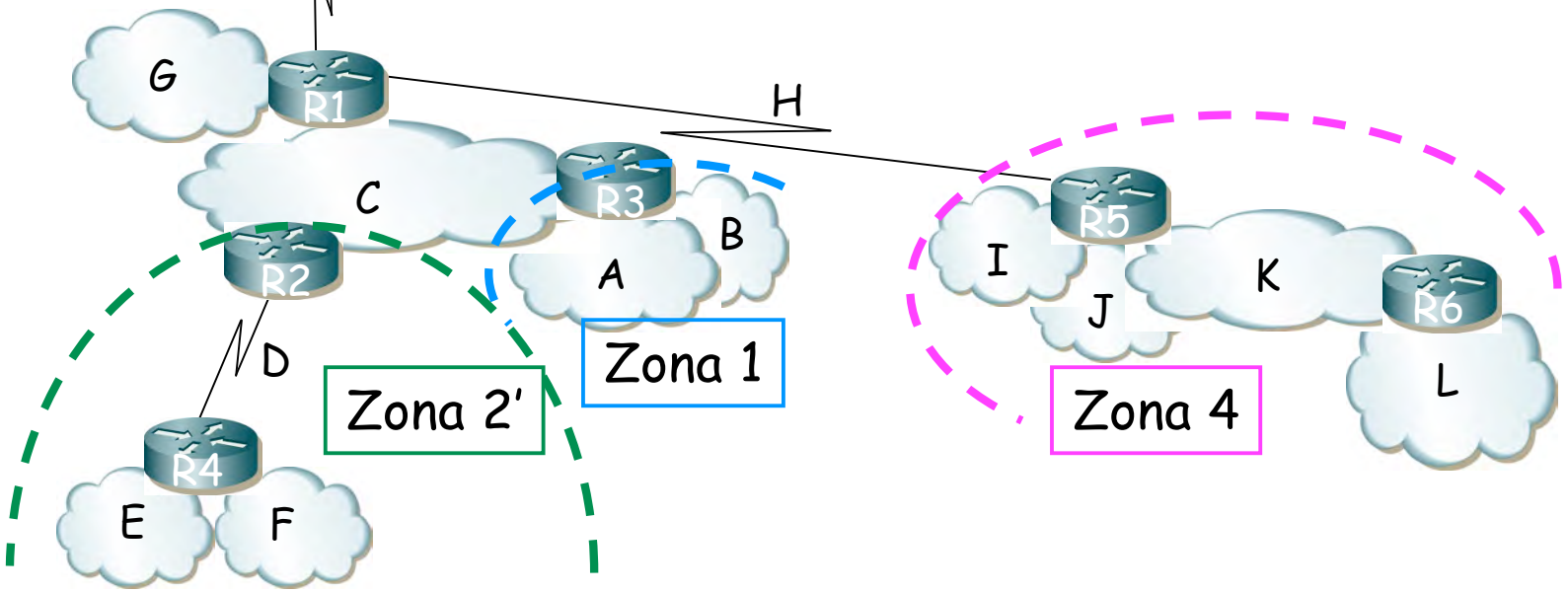
Destino		Next-hop	Interfaz
Red C	192.168.3.32 /28	(dir.connected)	ifR1RedC
Red G	192.168.3.48 /28	(dir.connected)	ifR1RedG
Red H	192.168.3.192 /30	(dir.connected)	ifR1RedH
Zona 4	192.168.3.128 /26	IPR5ifRedH	ifR1RedH
Zona 2'	192.168.3.64 /26	IPR2ifRedC	ifR1RedC



Ejemplo (4)

Tabla de rutas de R1:

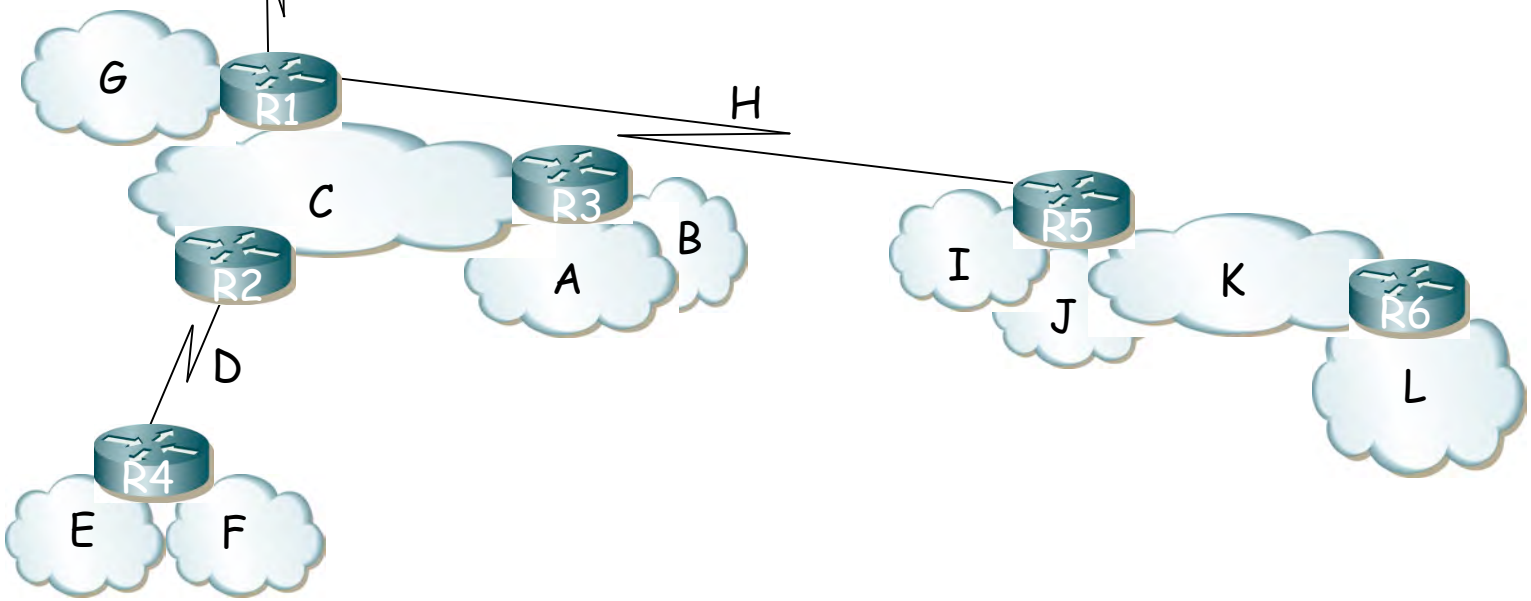
Destino		Next-hop	Interfaz
Red C	192.168.3.32 /28	(dir.connected)	ifR1RedC
Red G	192.168.3.48 /28	(dir.connected)	ifR1RedG
Red H	192.168.3.192 /30	(dir.connected)	ifR1RedH
Zona 4	192.168.3.128 /26	IPR5ifRedH	ifR1RedH
Zona 2'	192.168.3.64 /26	IPR2ifRedC	ifR1RedC
Zona 1	192.168.3.0 /27	IPR3ifRedC	ifR1RedC



Ejemplo (4)

Tabla de rutas de R5:

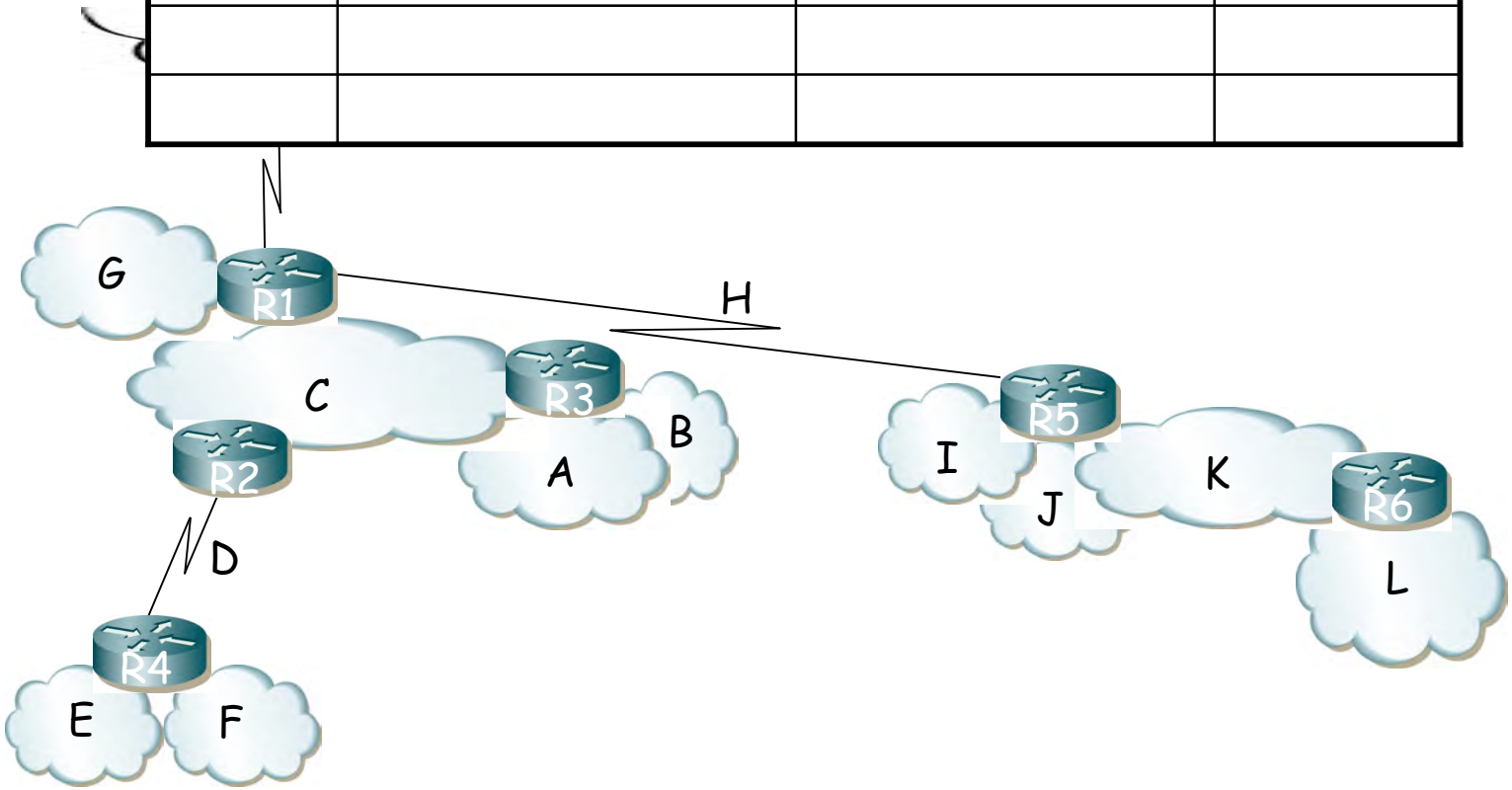
Destino		Next-hop	Interfaz



Ejemplo (4)

Tabla de rutas de R5:

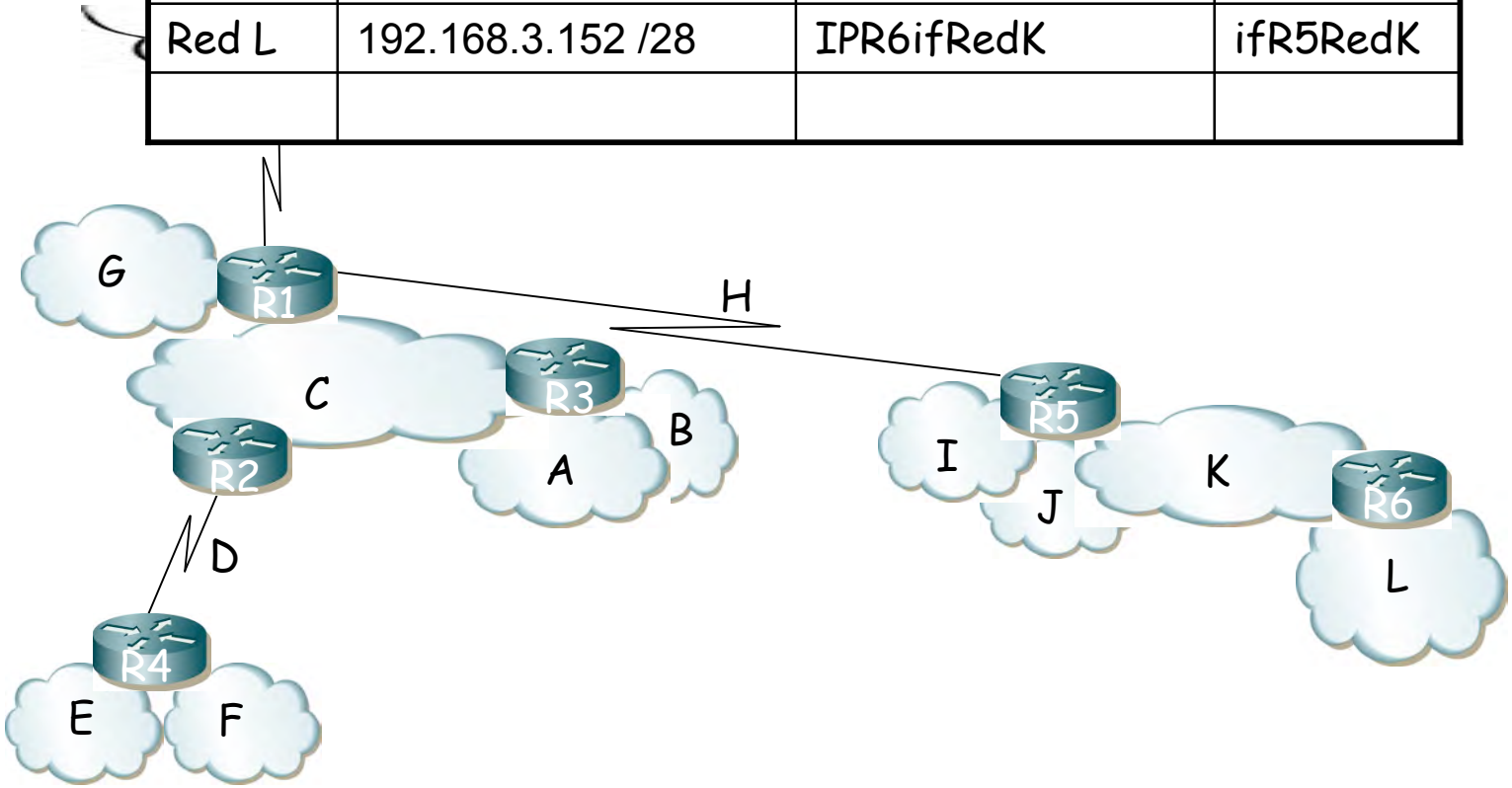
Destino		Next-hop	Interfaz
Red I	192.168.3.128 /28	(dir.connected)	ifR5RedI
Red J	192.168.3.136 /28	(dir.connected)	ifR5RedJ
Red K	192.168.3.136 /28	(dir.connected)	ifR5RedK
Red H	192.168.3.192 /30	(dir.connected)	ifR5RedH



Ejemplo (4)

Tabla de rutas de R5:

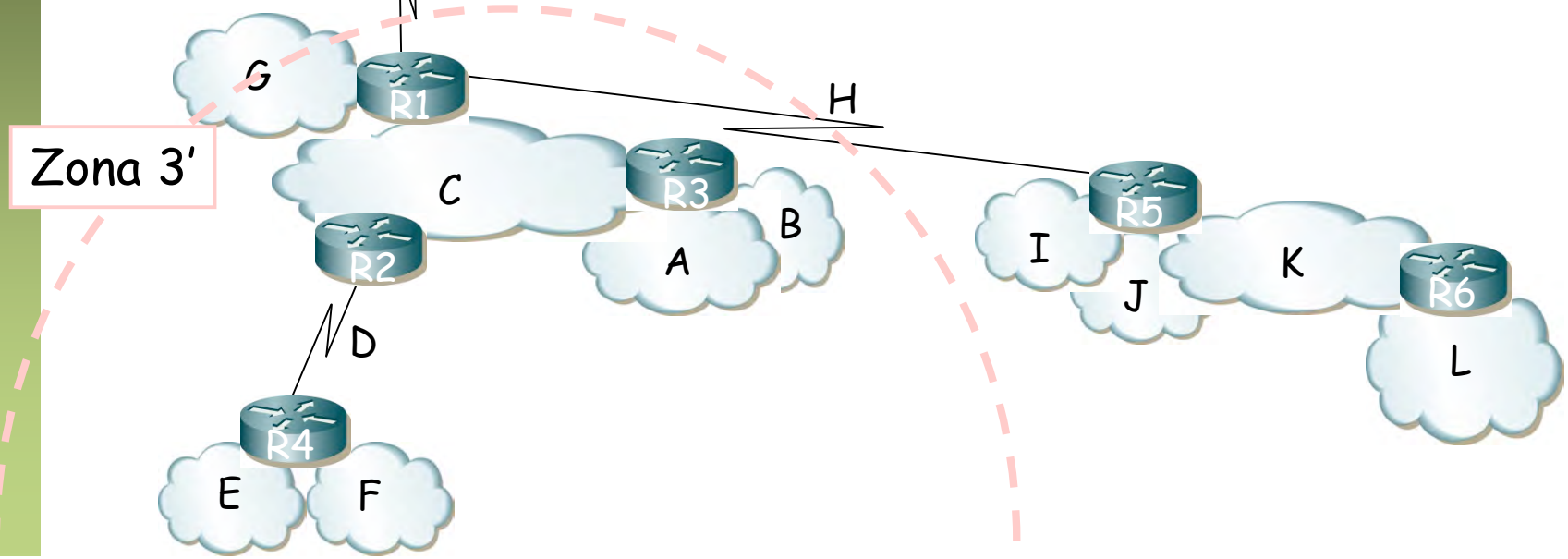
Destino		Next-hop	Interfaz
Red I	192.168.3.128 /28	(dir.connected)	ifR5RedI
Red J	192.168.3.136 /28	(dir.connected)	ifR5RedJ
Red K	192.168.3.136 /28	(dir.connected)	ifR5RedK
Red H	192.168.3.192 /30	(dir.connected)	ifR5RedH
Red L	192.168.3.152 /28	IPR6ifRedK	ifR5RedK



Ejemplo (4)

Tabla de rutas de R5:

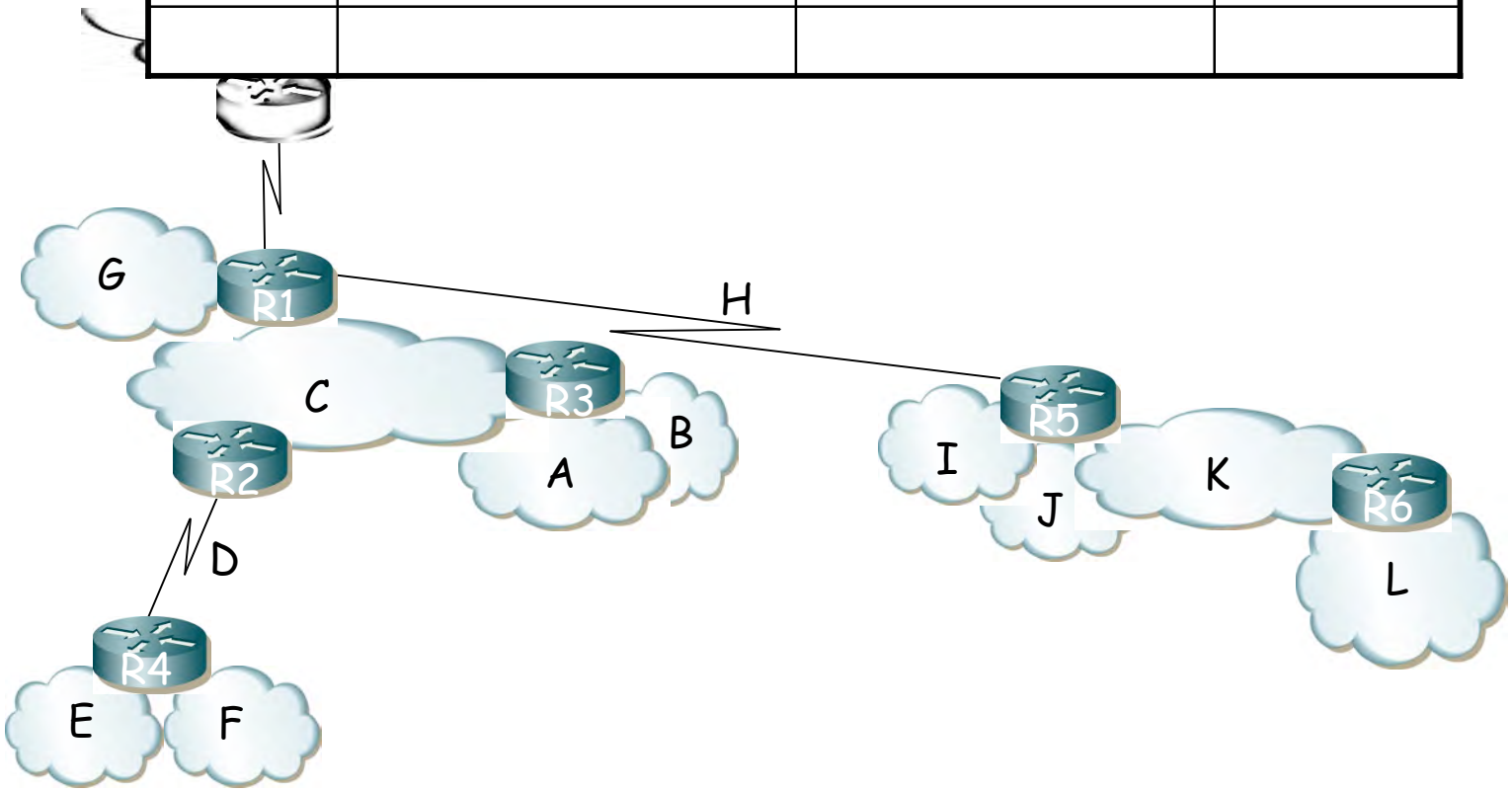
Destino		Next-hop	Interfaz
Red I	192.168.3.128 /28	(dir.connected)	ifR5RedI
Red J	192.168.3.136 /28	(dir.connected)	ifR5RedJ
Red K	192.168.3.136 /28	(dir.connected)	ifR5RedK
Red H	192.168.3.192 /30	(dir.connected)	ifR5RedH
Red L	192.168.3.152 /28	IPR6ifRedK	ifR5RedK
Zona 3'	192.168.3.0 /25	IPR1ifRedH	ifR5RedH



Ejemplo (4)

Tabla de rutas de R6:

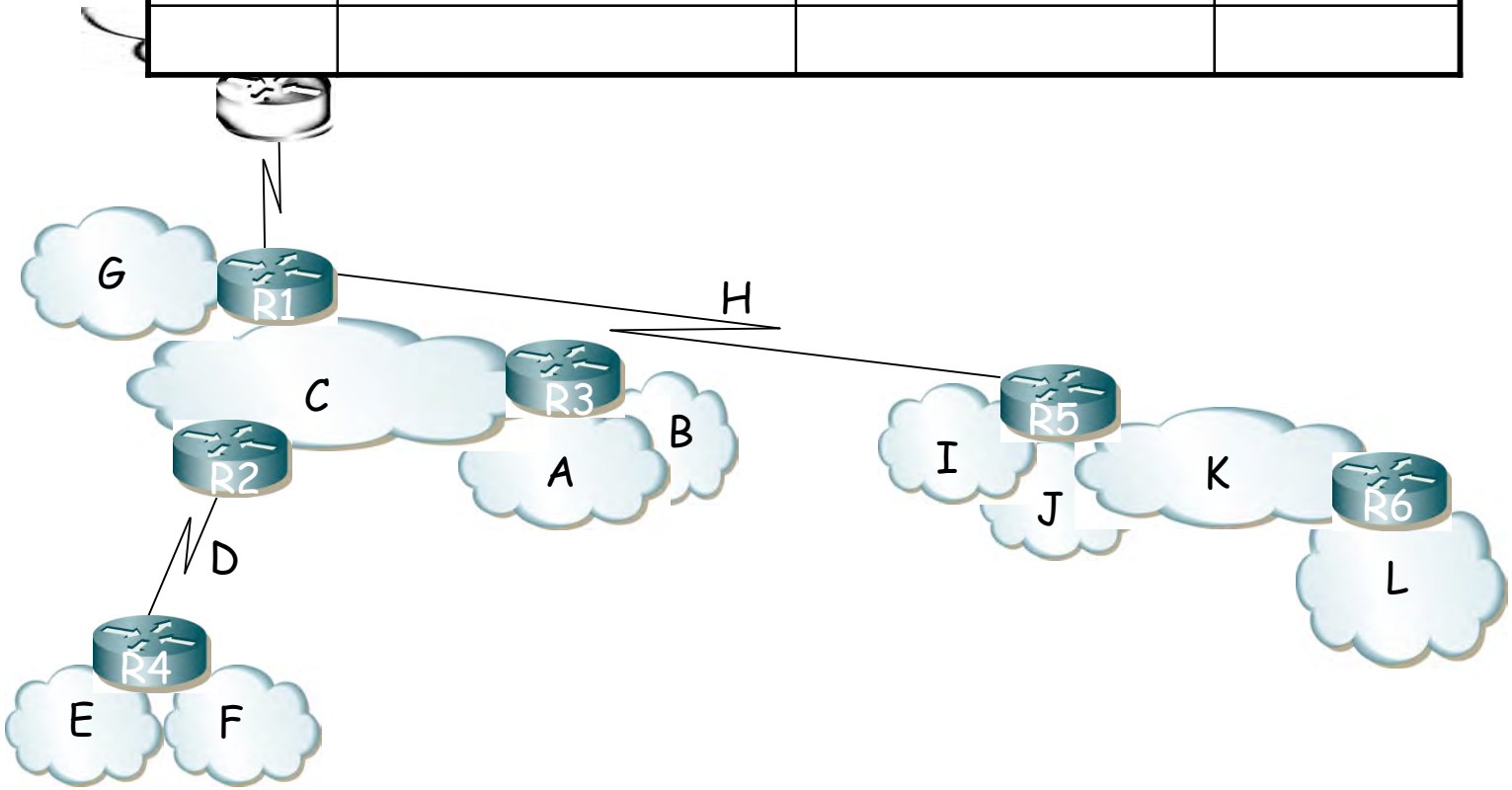
Destino		Next-hop	Interfaz



Ejemplo (4)

Tabla de rutas de R6:

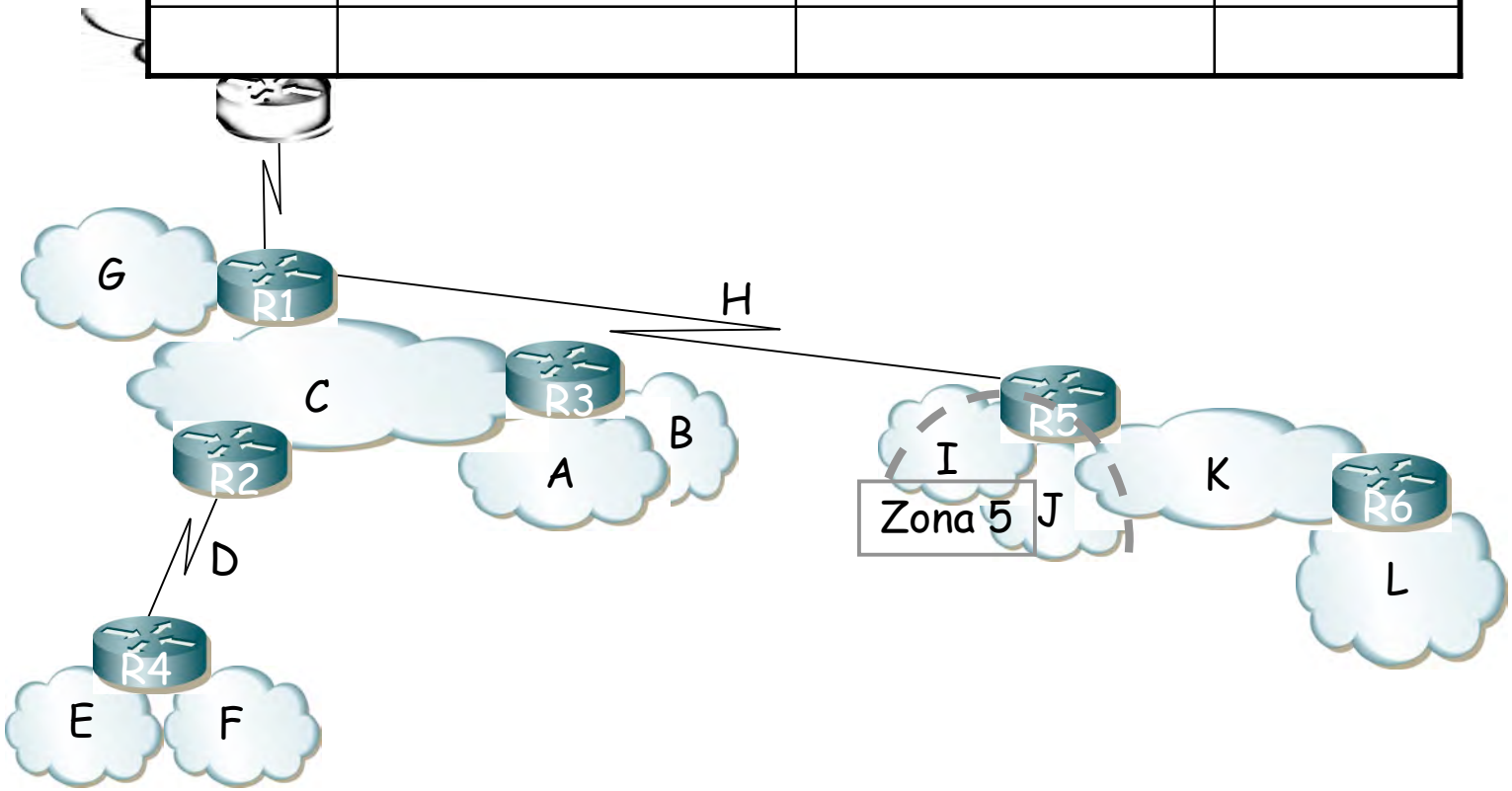
Destino		Next-hop	Interfaz
Red K	192.168.3.136 /28	(dir.connected)	ifR6RedK
Red L	192.168.3.152 /28	(dir.connected)	ifR6RedL



Ejemplo (4)

Tabla de rutas de R6:

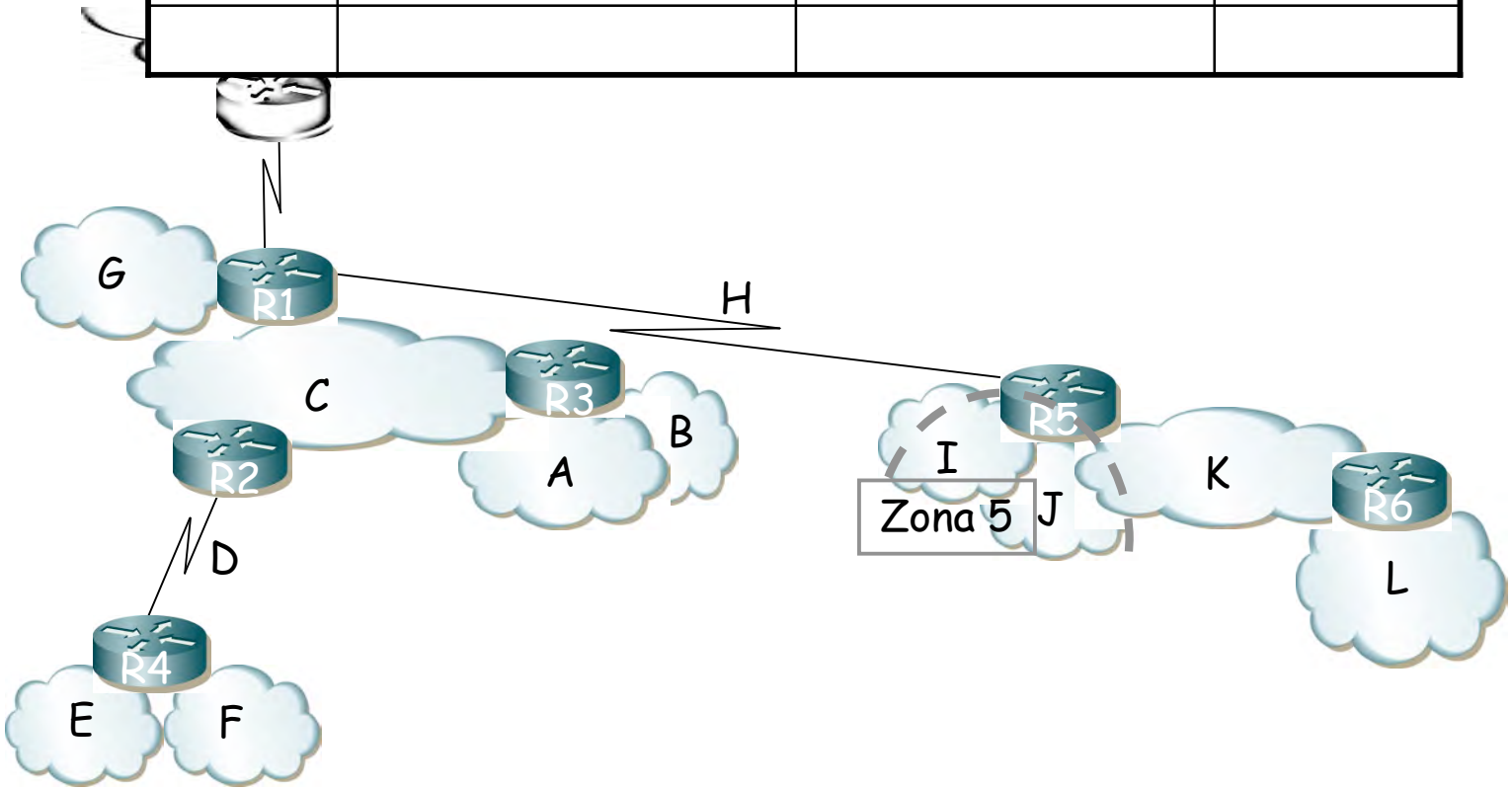
Destino		Next-hop	Interfaz
Red K	192.168.3.136 /28	(dir.connected)	ifR6RedK
Red L	192.168.3.152 /28	(dir.connected)	ifR6RedL
Zona 5	192.168.3.128 /27	IPR5ifRedK	ifR6RedK



Ejemplo (4)

Tabla de rutas de R6:

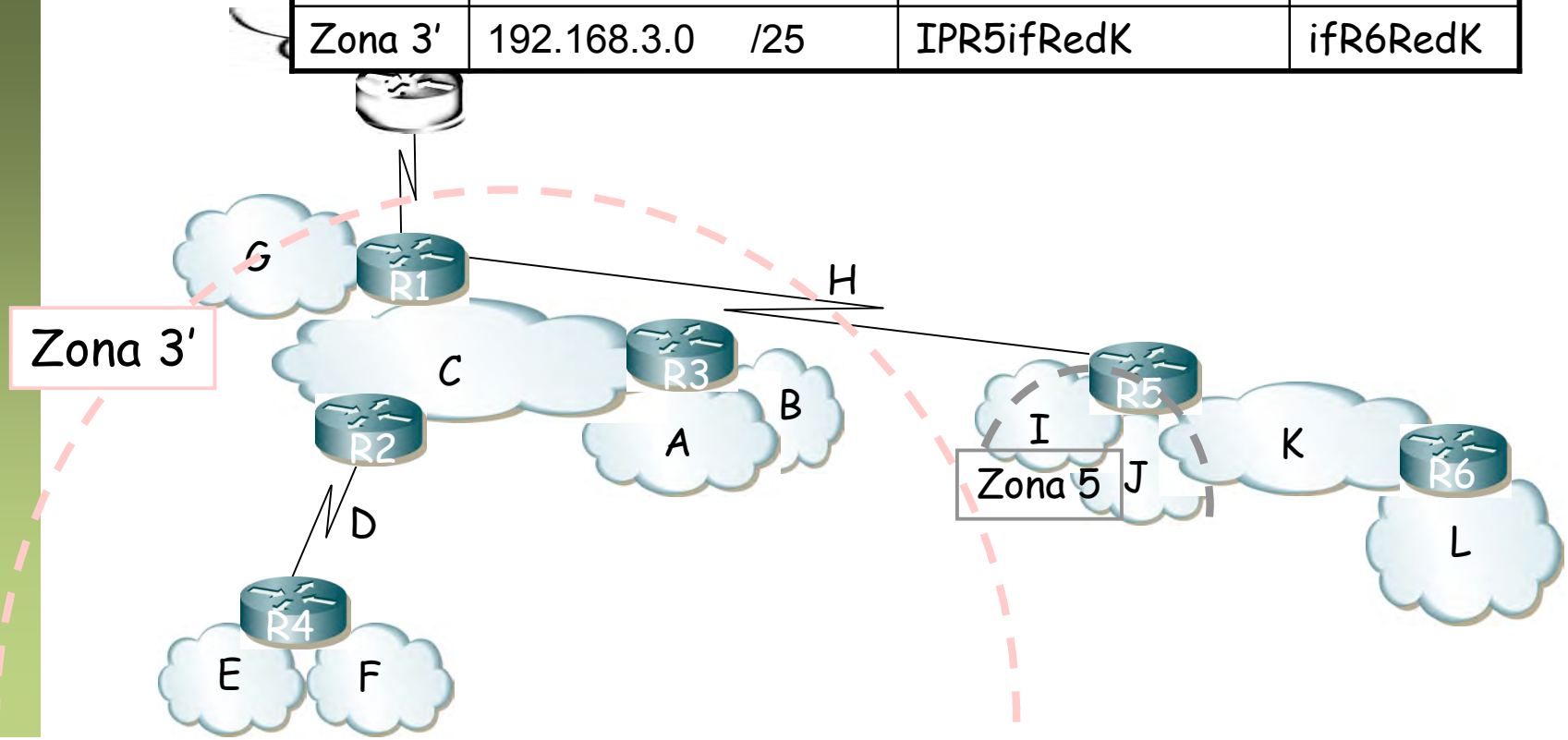
Destino		Next-hop	Interfaz
Red K	192.168.3.136 /28	(dir.connected)	ifR6RedK
Red L	192.168.3.152 /28	(dir.connected)	ifR6RedL
Zona 5	192.168.3.128 /27	IPR5ifRedK	ifR6RedK
Red H	192.168.3.192 /30	IPR5ifRedK	ifR6RedK



Ejemplo (4)

Tabla de rutas de R6:

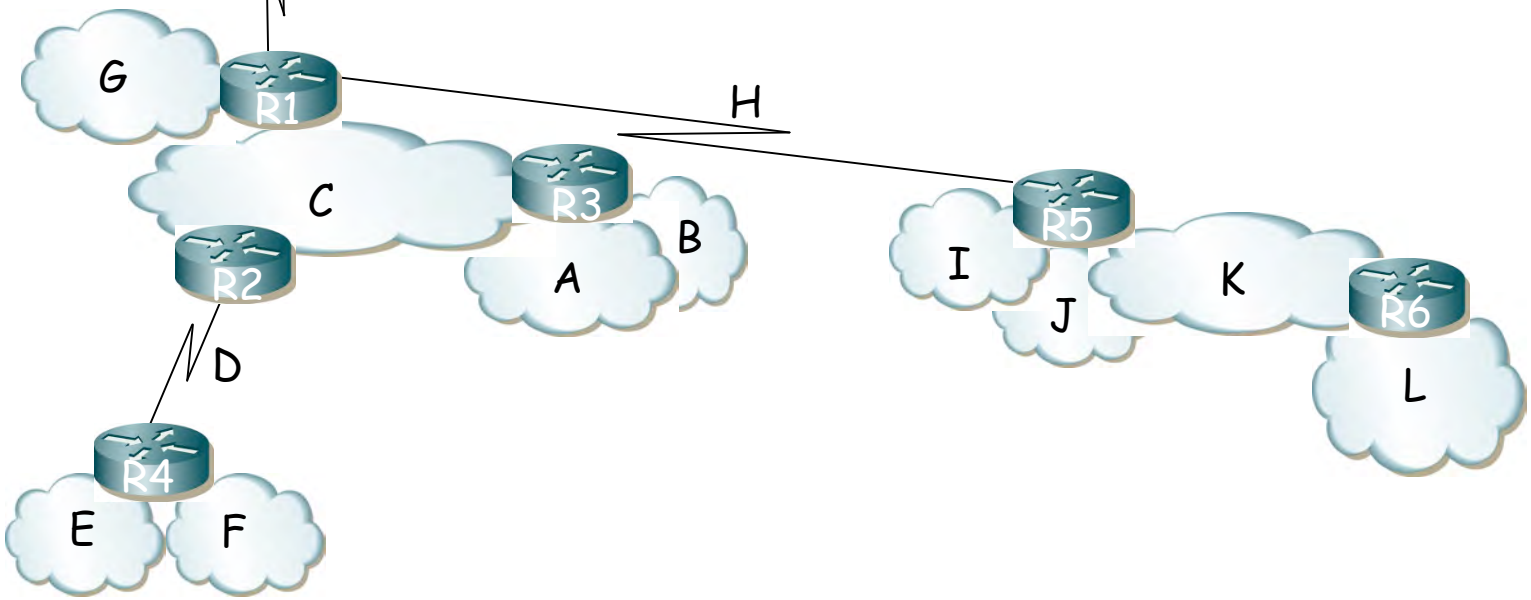
Destino		Next-hop	Interfaz
Red K	192.168.3.136 /28	(dir.connected)	ifR6RedK
Red L	192.168.3.152 /28	(dir.connected)	ifR6RedL
Zona 5	192.168.3.128 /27	IPR5ifRedK	ifR6RedK
Red H	192.168.3.192 /30	IPR5ifRedK	ifR6RedK
Zona 3'	192.168.3.0 /25	IPR5ifRedK	ifR6RedK



Ejemplo (4)

Tabla de rutas de R3:

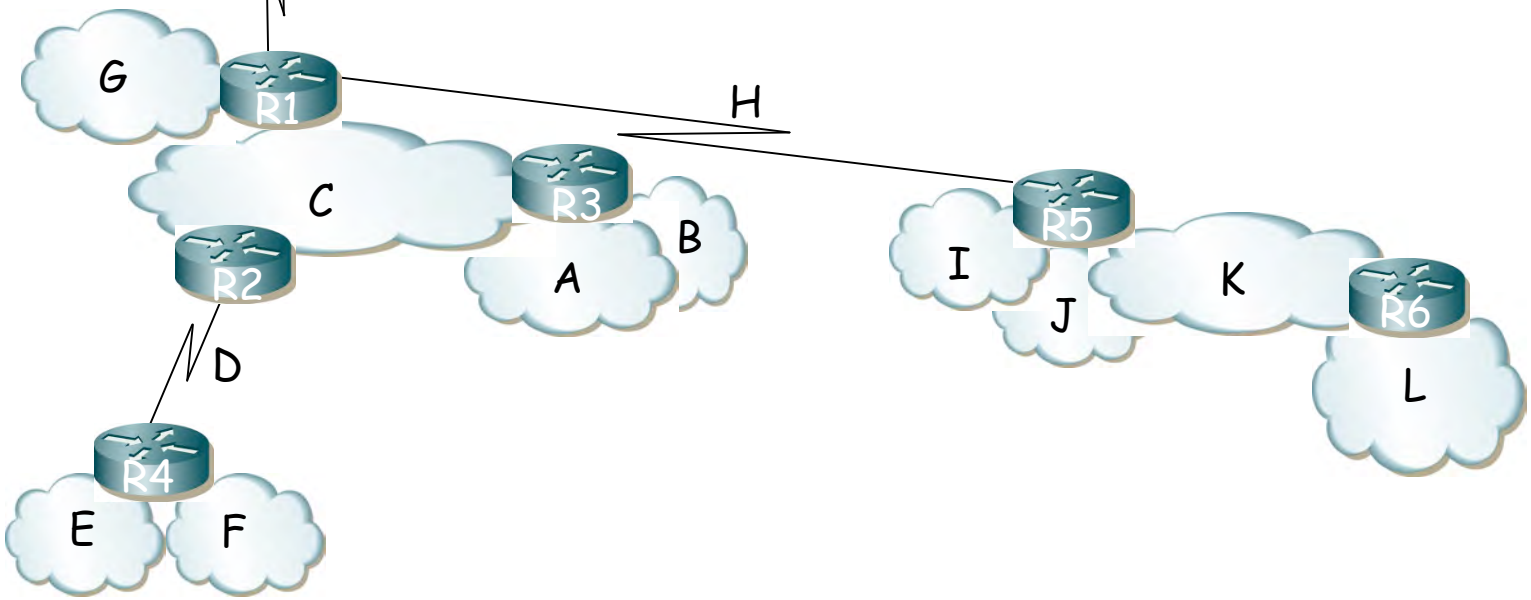
Destino		Next-hop	Interfaz



Ejemplo (4)

Tabla de rutas de R3:

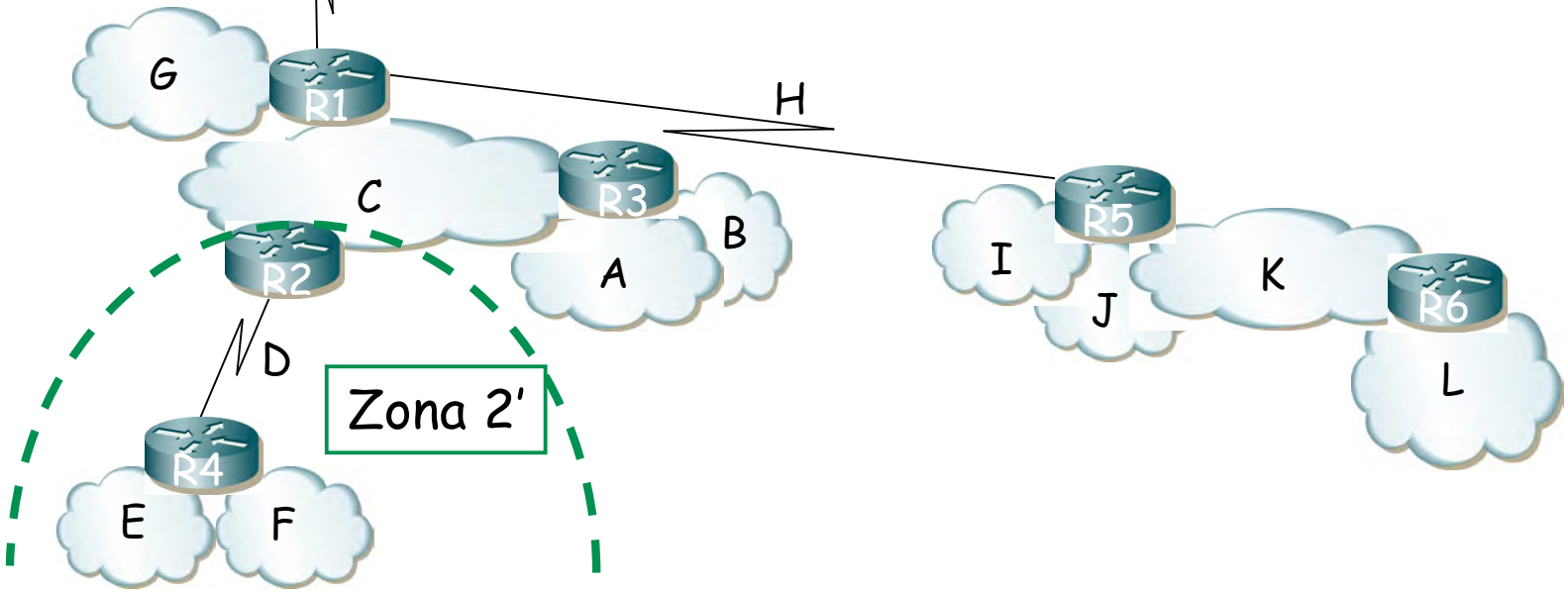
Destino		Next-hop	Interfaz
Red A	192.168.3.0 /28	(dir.connected)	ifR3RedA
Red B	192.168.3.16 /28	(dir.connected)	ifR3RedB
Red C	192.168.3.32 /28	(dir.connected)	ifR3RedC



Ejemplo (4)

Tabla de rutas de R3:

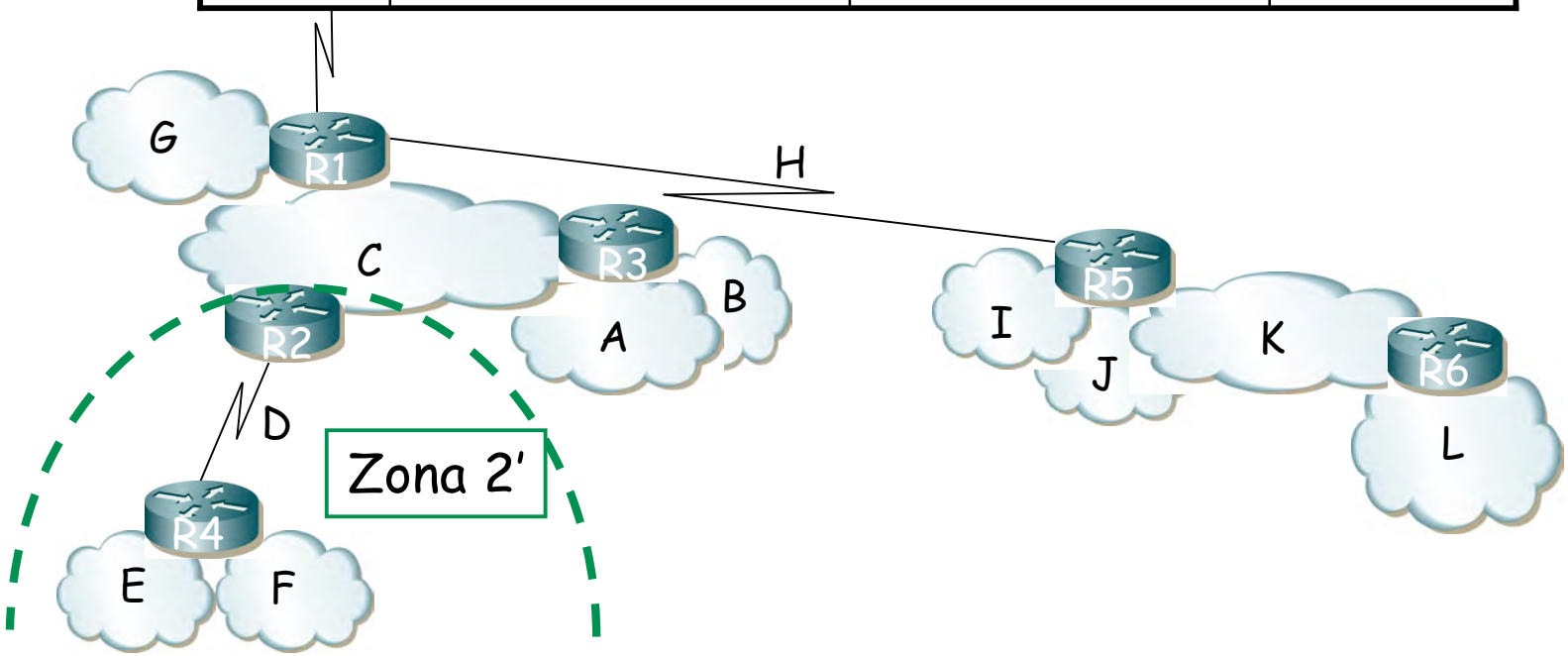
Destino		Next-hop	Interfaz
Red A	192.168.3.0 /28	(dir.connected)	ifR3RedA
Red B	192.168.3.16 /28	(dir.connected)	ifR3RedB
Red C	192.168.3.32 /28	(dir.connected)	ifR3RedC
Zona 2'	192.168.3.64 /26	IPR2ifRedC	ifR3RedC



Ejemplo (4)

Tabla de rutas de R3:

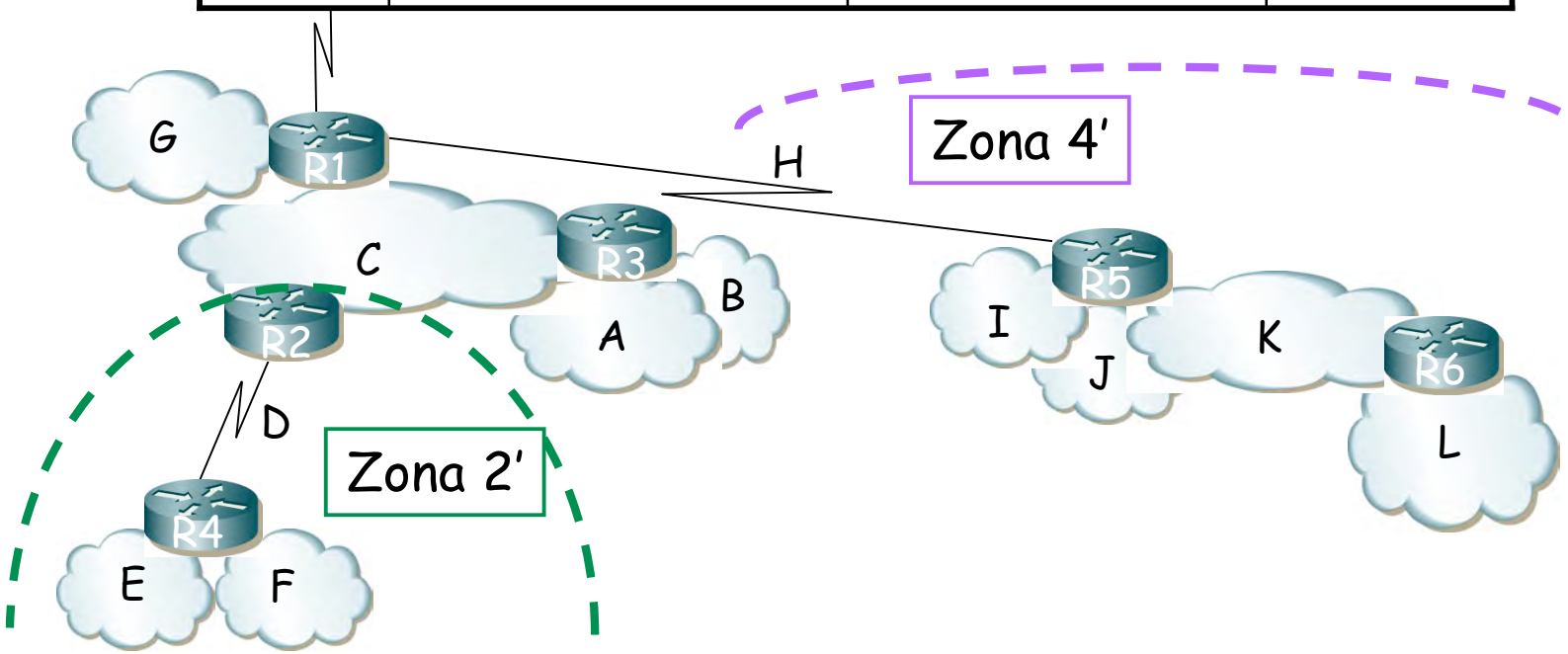
Destino		Next-hop	Interfaz
Red *A*	192.168.3.0 /28	(dir.connected)	ifR3RedA
Red B	192.168.3.16 /28	(dir.connected)	ifR3RedB
Red *C*	192.168.3.32 /28	(dir.connected)	ifR3RedC
Zona 2'	192.168.3.64 /26	IPR2ifRedC	ifR3RedC
Red *G*	192.168.3.48 /28	IPR1ifRedC	ifR3RedC



Ejemplo (4)

Tabla de rutas de R3:

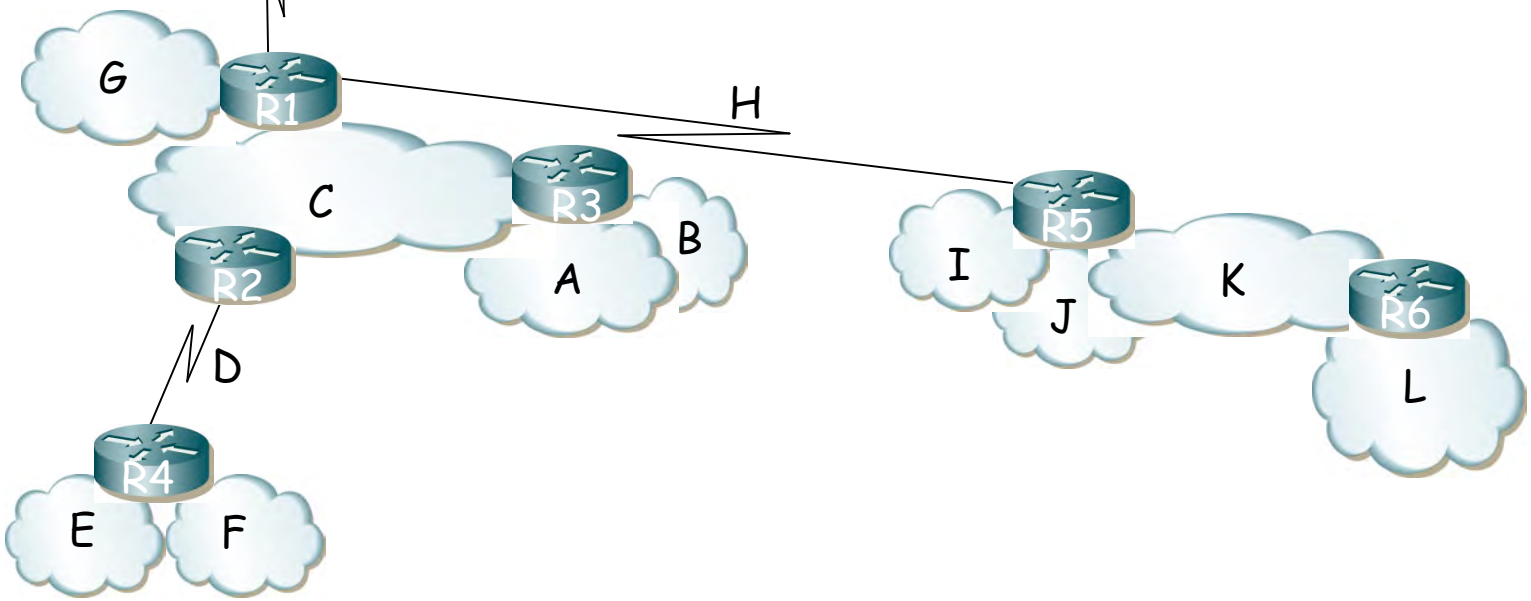
Destino		Next-hop	Interfaz
Red *A*	192.168.3.0 /28	(dir.connected)	ifR3RedA
Red B	192.168.3.16 /28	(dir.connected)	ifR3RedB
Red *C*	192.168.3.32 /28	(dir.connected)	ifR3RedC
Zona 2'	192.168.3.64 /26	IPR2ifRedC	ifR3RedC
Red *G*	192.168.3.48 /28	IPR1ifRedC	ifR3RedC
Zona 4'	192.168.3.128 /25	IPR1ifRedC	ifR3RedC



Ejemplo (4)

Tabla de rutas de R2:

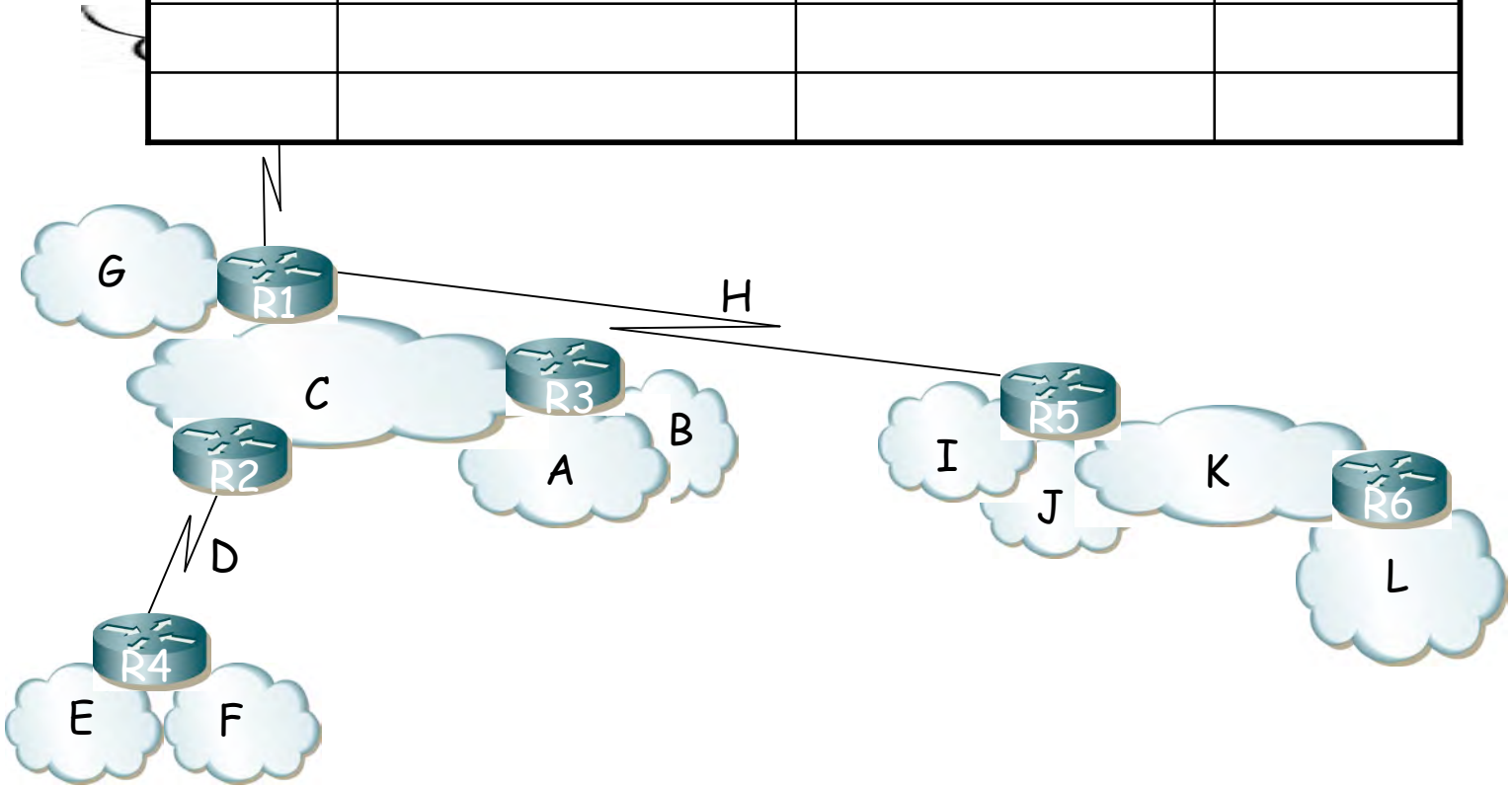
Destino		Next-hop	Interfaz



Ejemplo (4)

Tabla de rutas de R2:

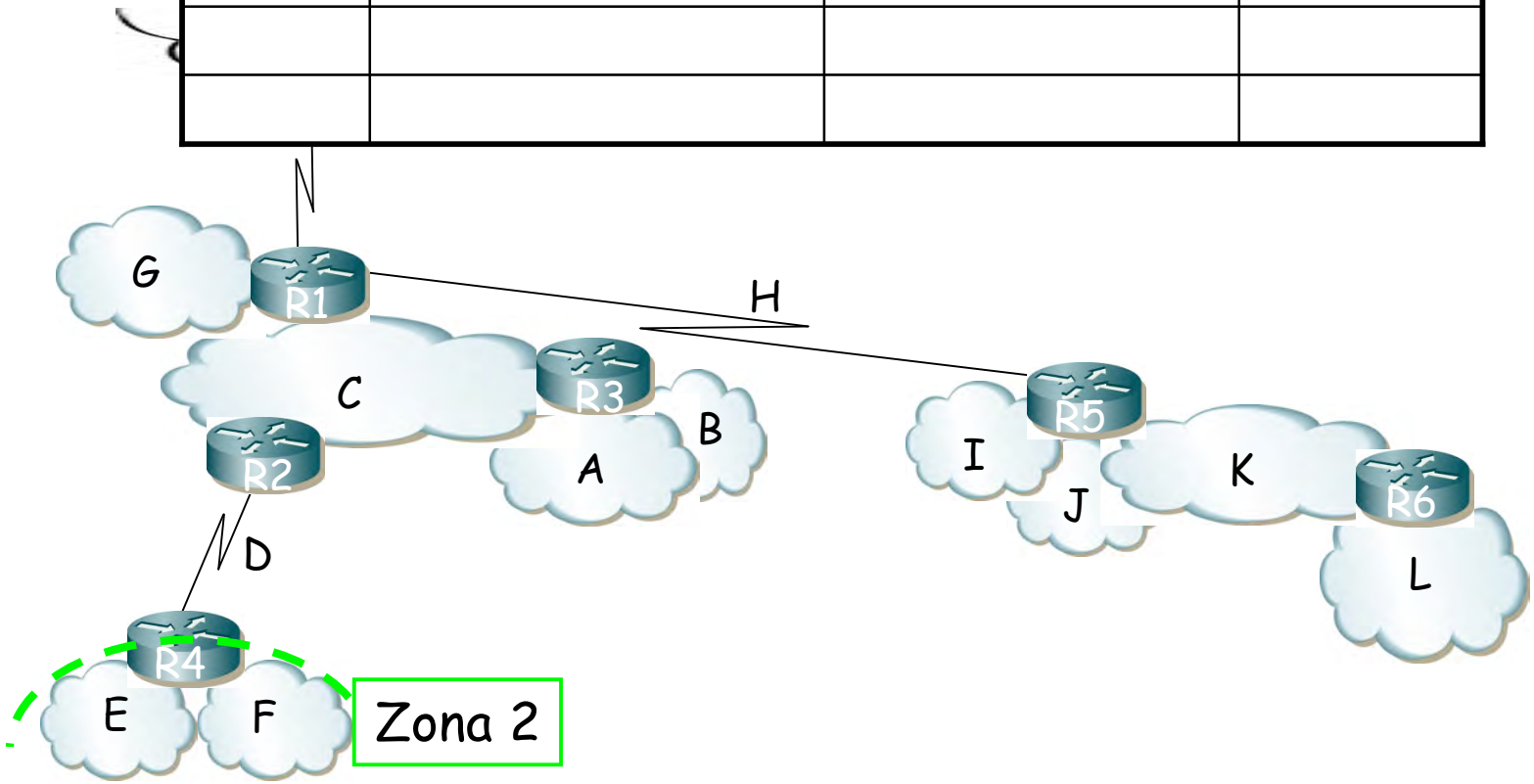
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR2RedD
Red C	192.168.3.32 /28	(dir.connected)	ifR2RedC



Ejemplo (4)

Tabla de rutas de R2:

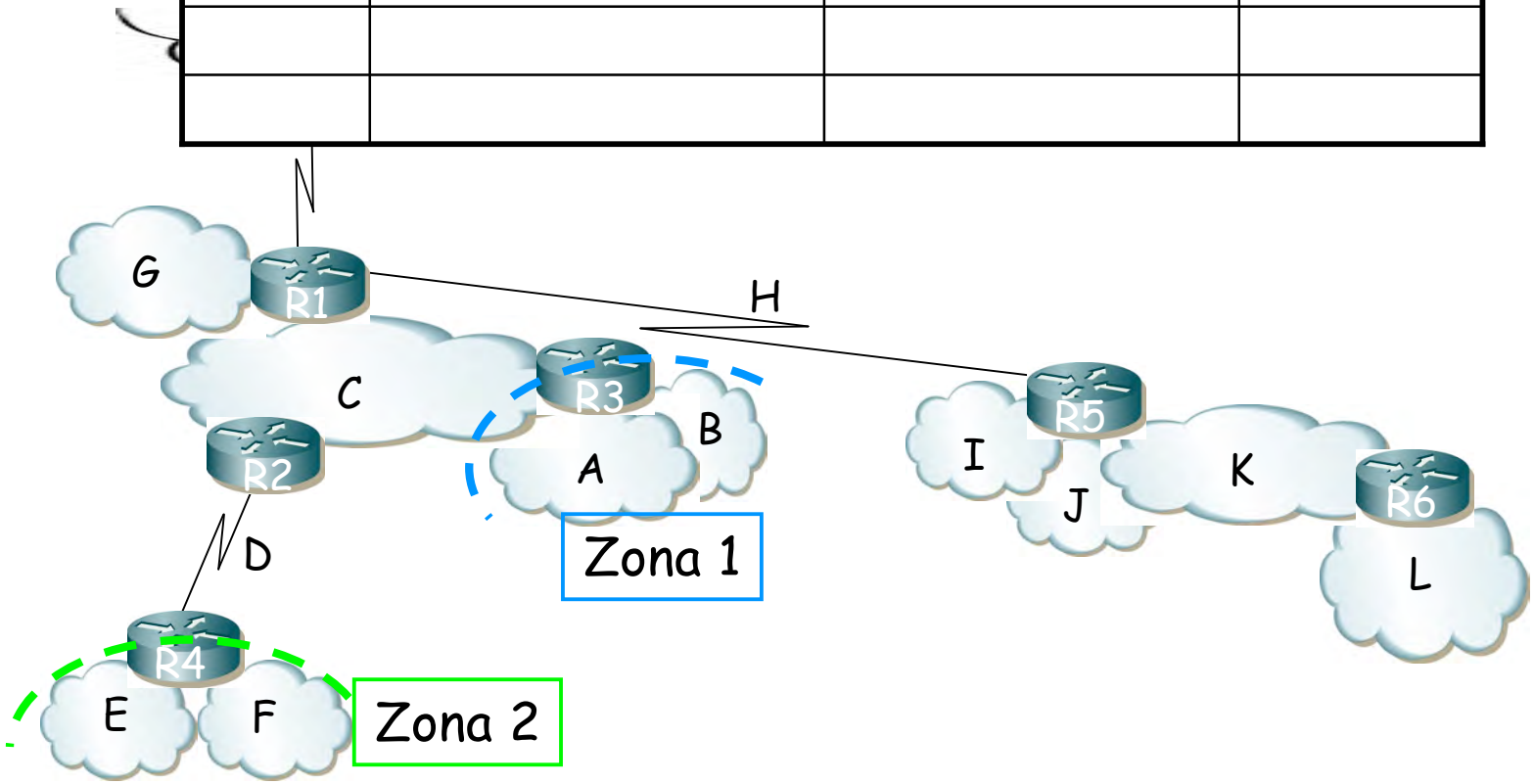
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR2RedD
Red C	192.168.3.32 /28	(dir.connected)	ifR2RedC
Zona 2	192.168.3.64 /27	IPR4ifRedD	ifR2RedD



Ejemplo (4)

Tabla de rutas de R2:

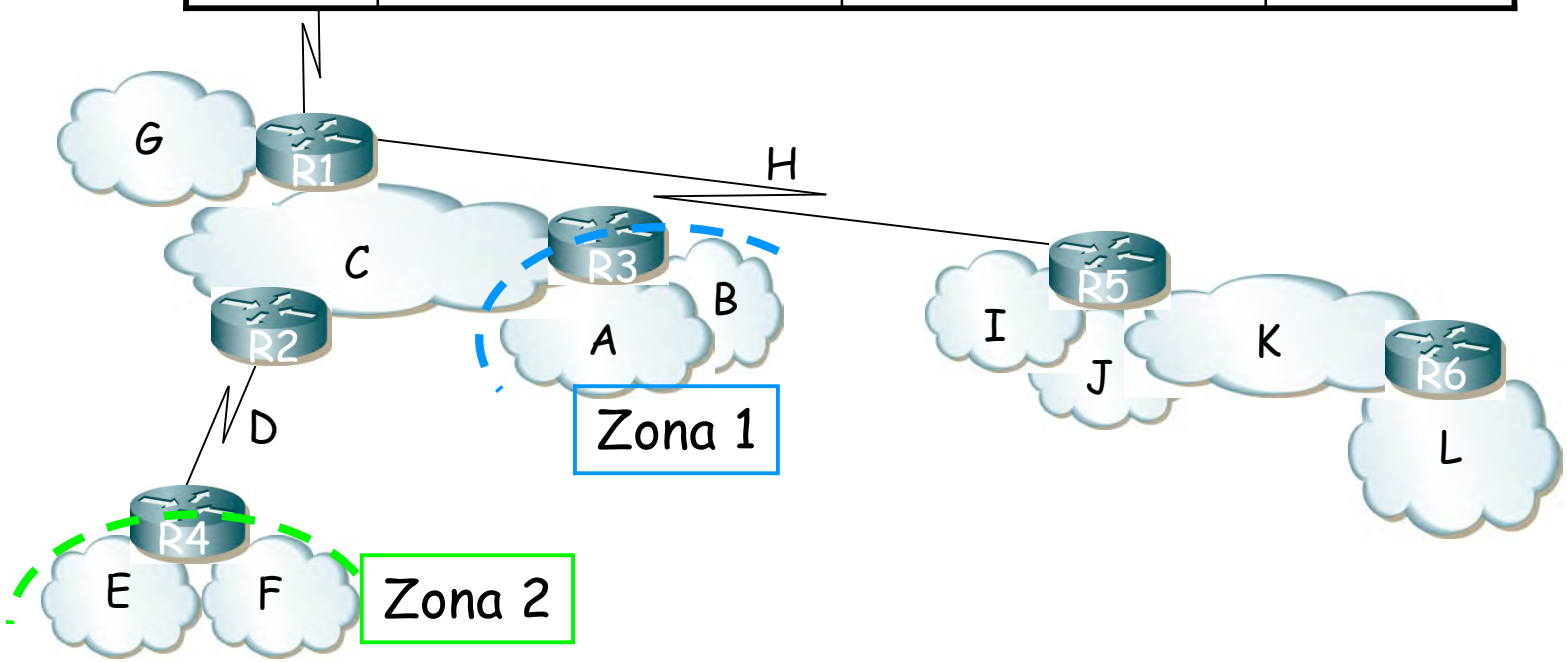
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR2RedD
Red C	192.168.3.32 /28	(dir.connected)	ifR2RedC
Zona 2	192.168.3.64 /27	IPR4ifRedD	ifR2RedD
Zona 1	192.168.3.0 /27	IPR3ifRedC	ifR2RedC



Ejemplo (4)

Tabla de rutas de R2:

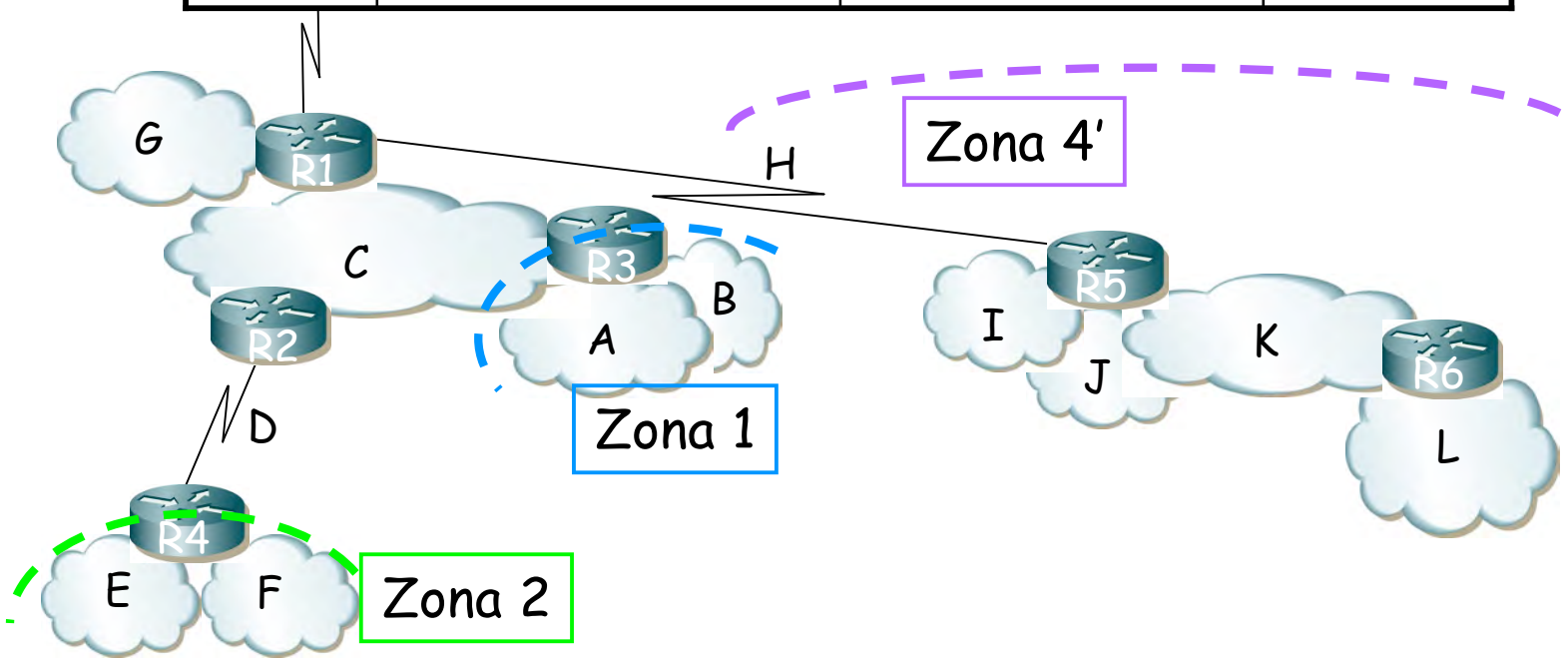
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR2RedD
Red C	192.168.3.32 /28	(dir.connected)	ifR2RedC
Zona 2	192.168.3.64 /27	IPR4ifRedD	ifR2RedD
Zona 1	192.168.3.0 /27	IPR3ifRedC	ifR2RedC
Red G	192.168.3.48 /28	IPR1ifRedC	ifR2RedC



Ejemplo (4)

Tabla de rutas de R2:

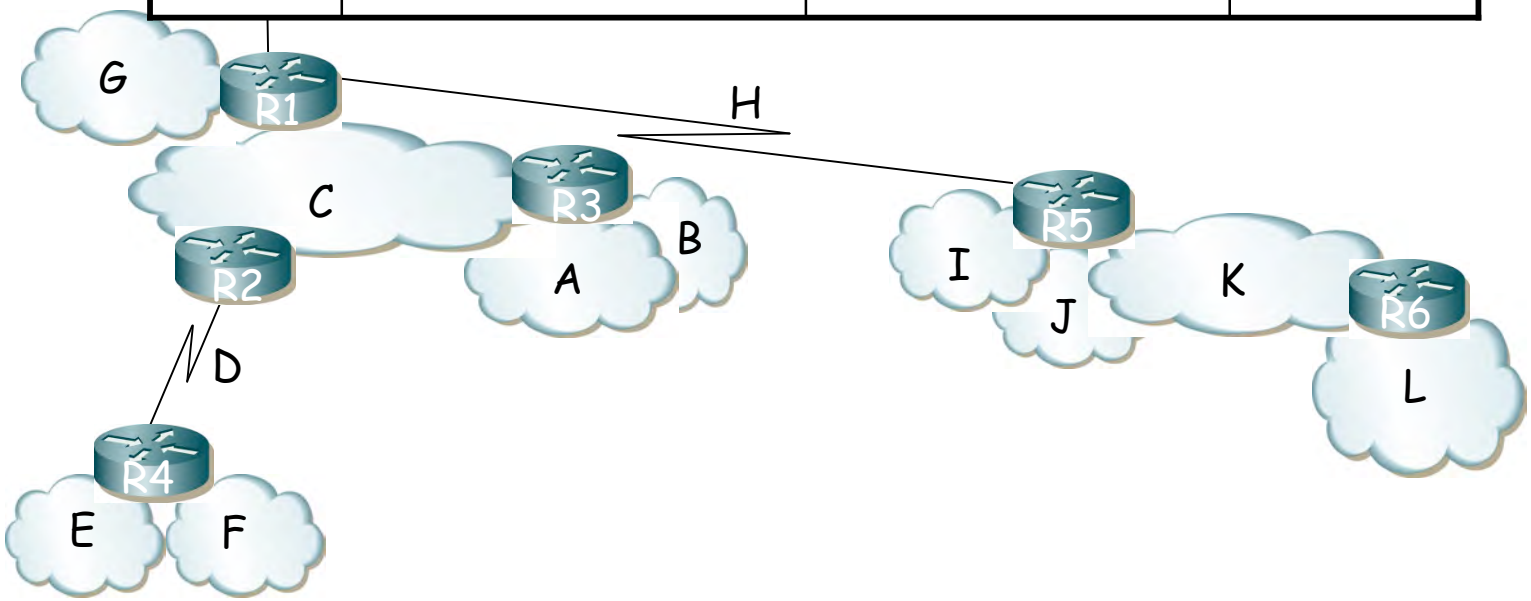
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR2RedD
Red C	192.168.3.32 /28	(dir.connected)	ifR2RedC
Zona 2	192.168.3.64 /27	IPR4ifRedD	ifR2RedD
Zona 1	192.168.3.0 /27	IPR3ifRedC	ifR2RedC
Red G	192.168.3.48 /28	IPR1ifRedC	ifR2RedC
Zona 4'	192.168.3.128 /25	IPR1ifRedC	ifR2RedC



Ejemplo (4)

Tabla de rutas de R4:

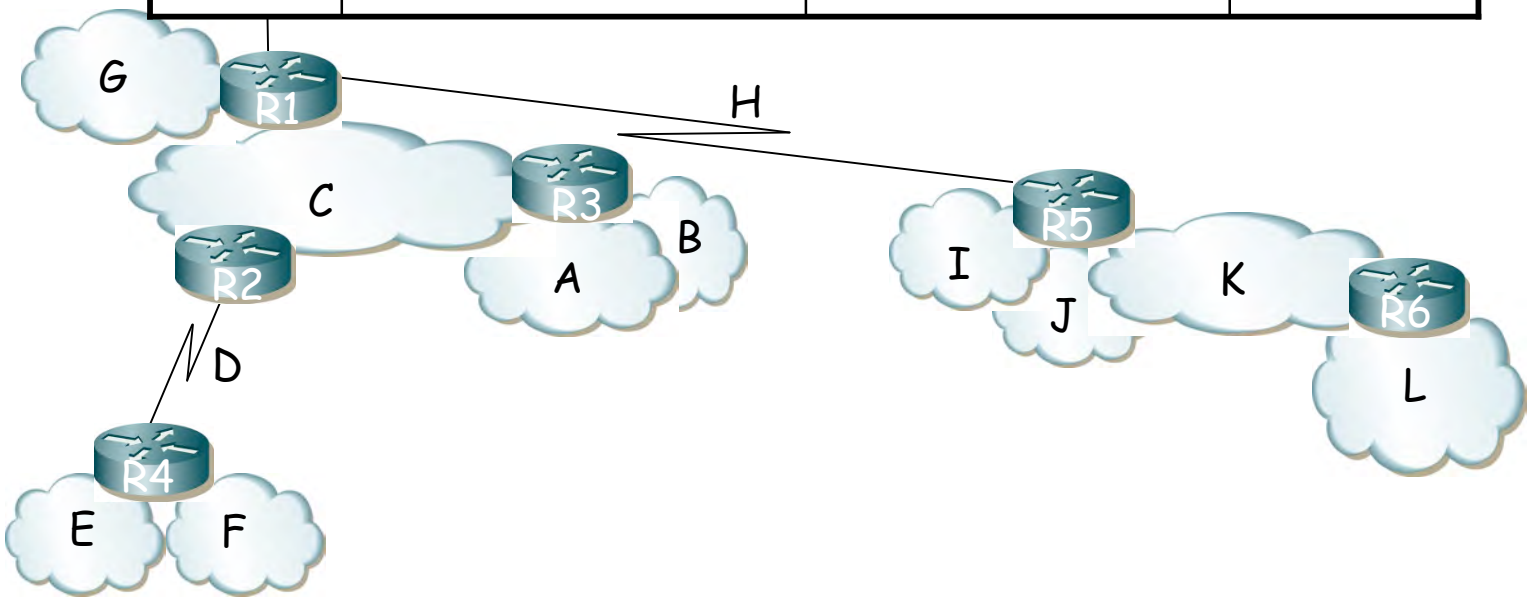
Destino		Next-hop	Interfaz



Ejemplo (4)

Tabla de rutas de R4:

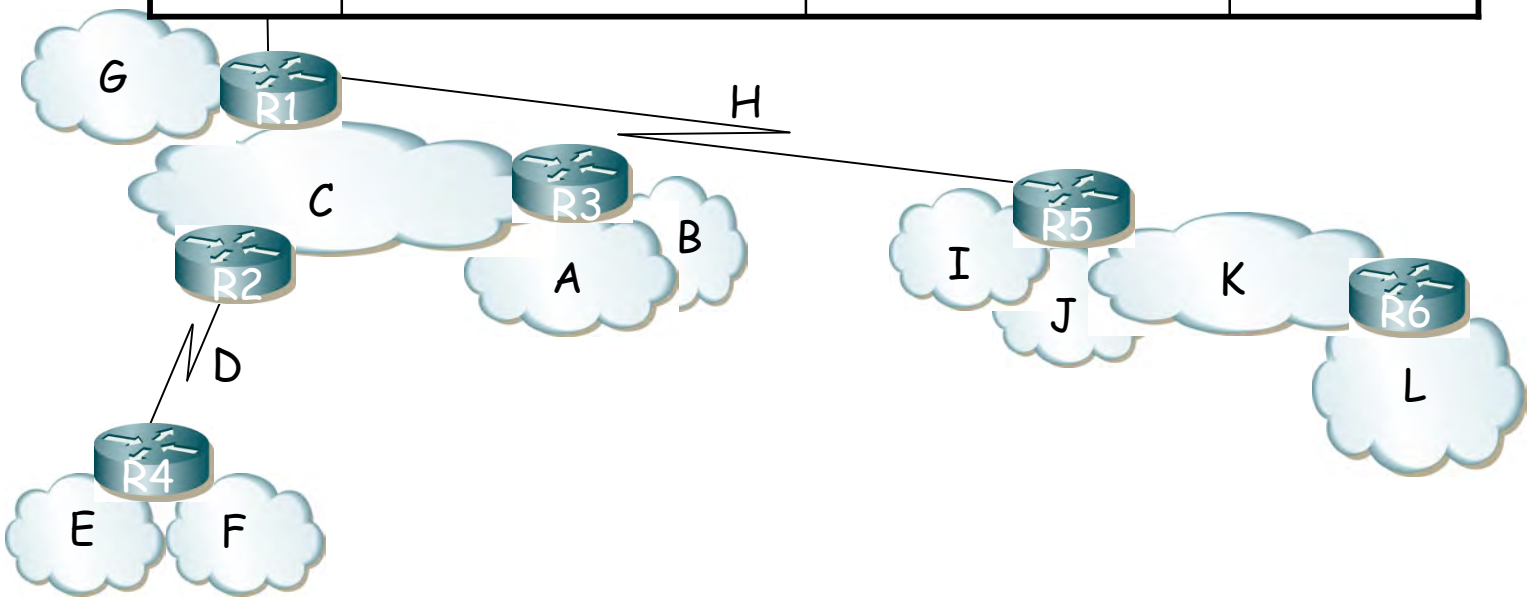
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF



Ejemplo (4)

Tabla de rutas de R4:

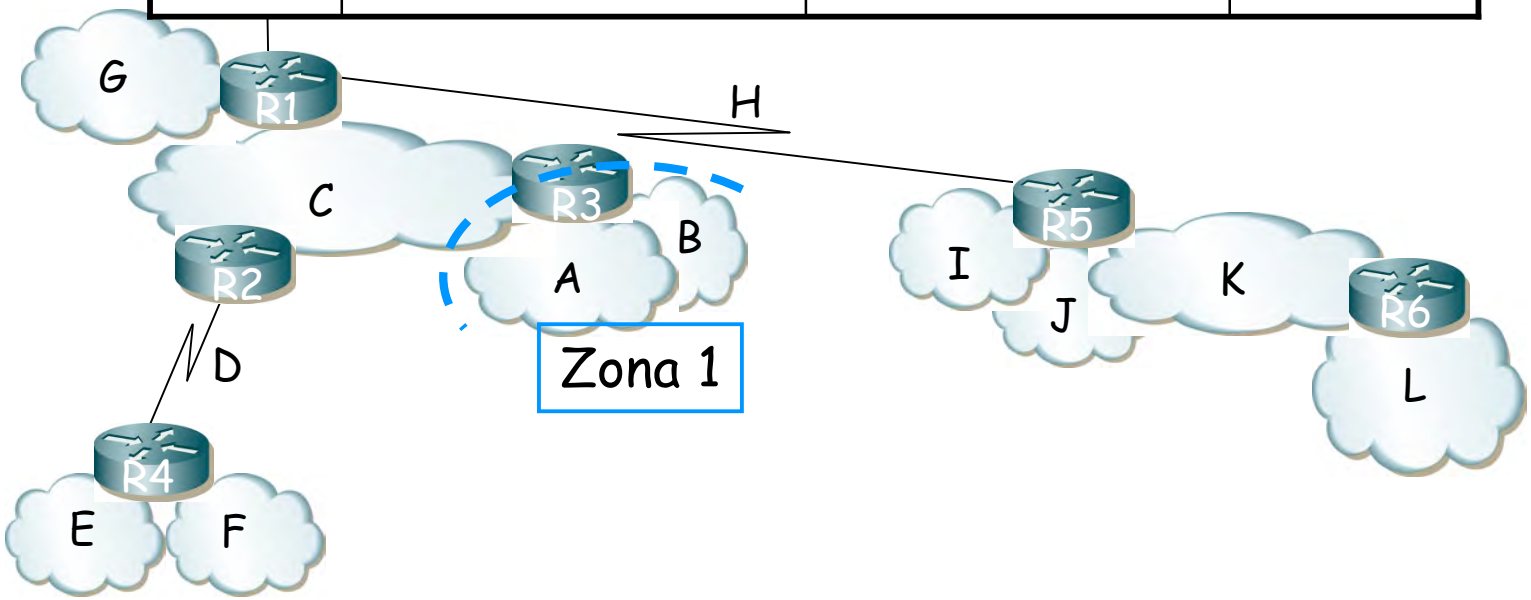
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
Red C	192.168.3.32 /28	IPR2ifRedD	ifR4RedD



Ejemplo (4)

Tabla de rutas de R4:

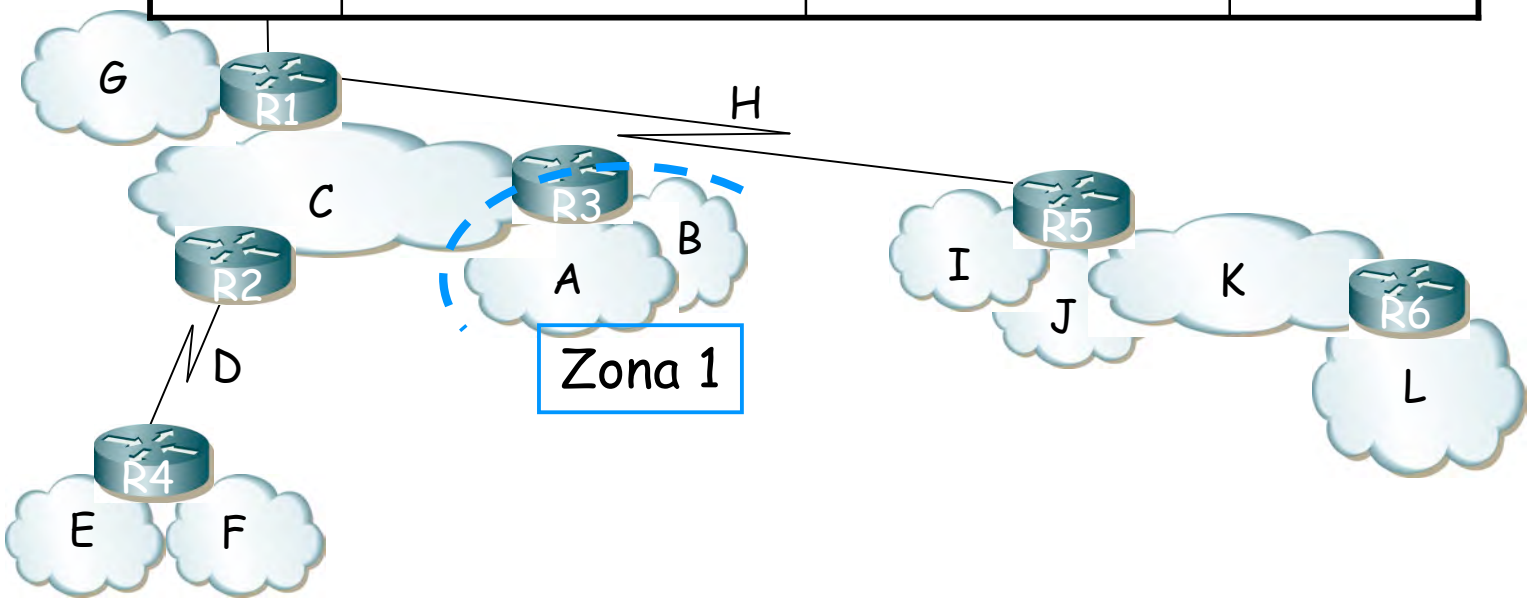
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
Red C	192.168.3.32 /28	IPR2ifRedD	ifR4RedD
Zona 1	192.168.3.0 /27	IPR2ifRedD	ifR4RedD



Ejemplo (4)

Tabla de rutas de R4:

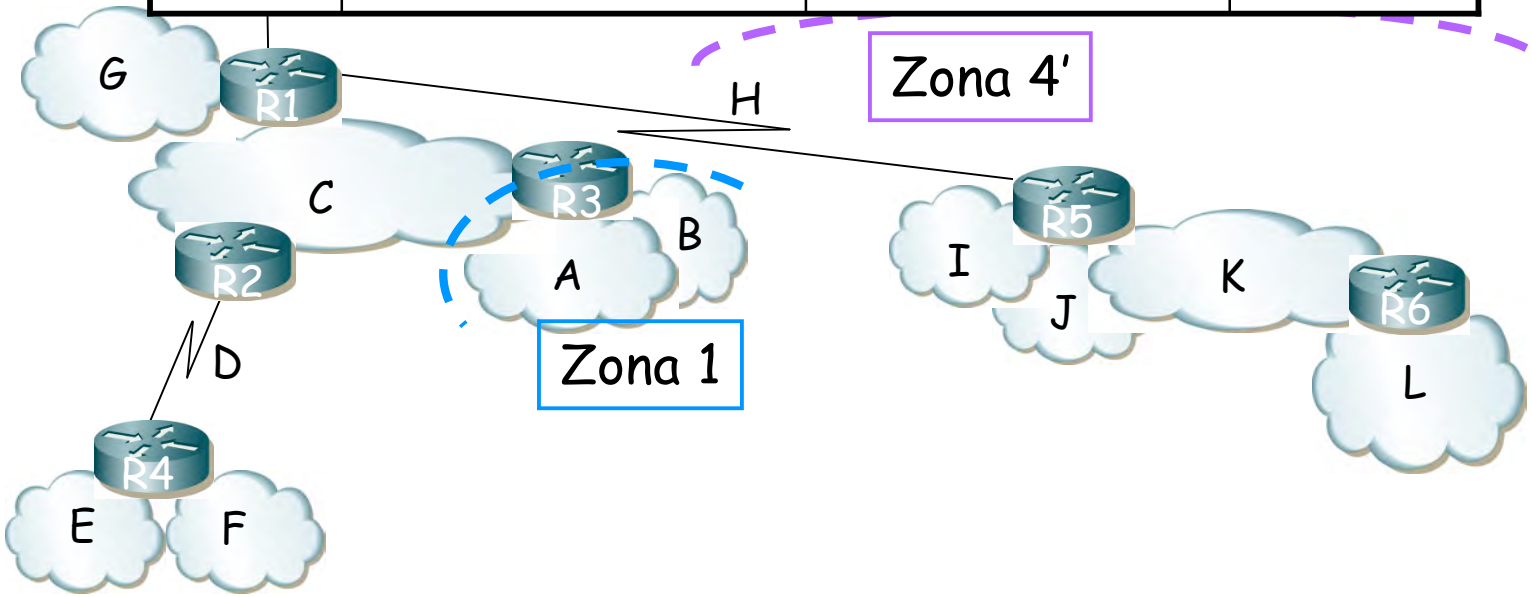
Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
Red C	192.168.3.32 /28	IPR2ifRedD	ifR4RedD
Zona 1	192.168.3.0 /27	IPR2ifRedD	ifR4RedD
Red G	192.168.3.48 /28	IPR2ifRedD	ifR4RedD



Ejemplo (4)

Tabla de rutas de R4:

Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
Red C	192.168.3.32 /28	IPR2ifRedD	ifR4RedD
Zona 1	192.168.3.0 /27	IPR2ifRedD	ifR4RedD
Red G	192.168.3.48 /28	IPR2ifRedD	ifR4RedD
Zona 4'	192.168.3.128 /25	IPR2ifRedD	ifR4RedD

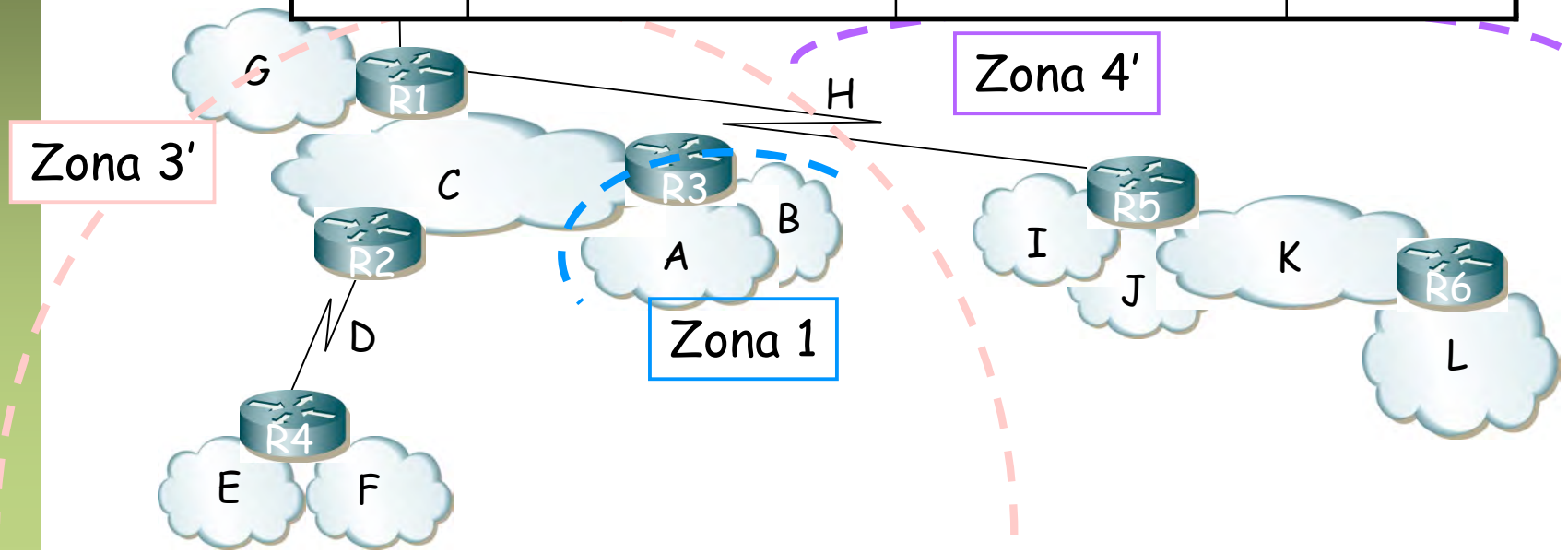


Ejemplo (4)

Mejora 1

Tabla de rutas de R4:

Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
Zona 3'	192.168.3.0 /25	IPR2ifRedD	ifR4RedD
Zona 4'	192.168.3.128 /25	IPR2ifRedD	ifR4RedD

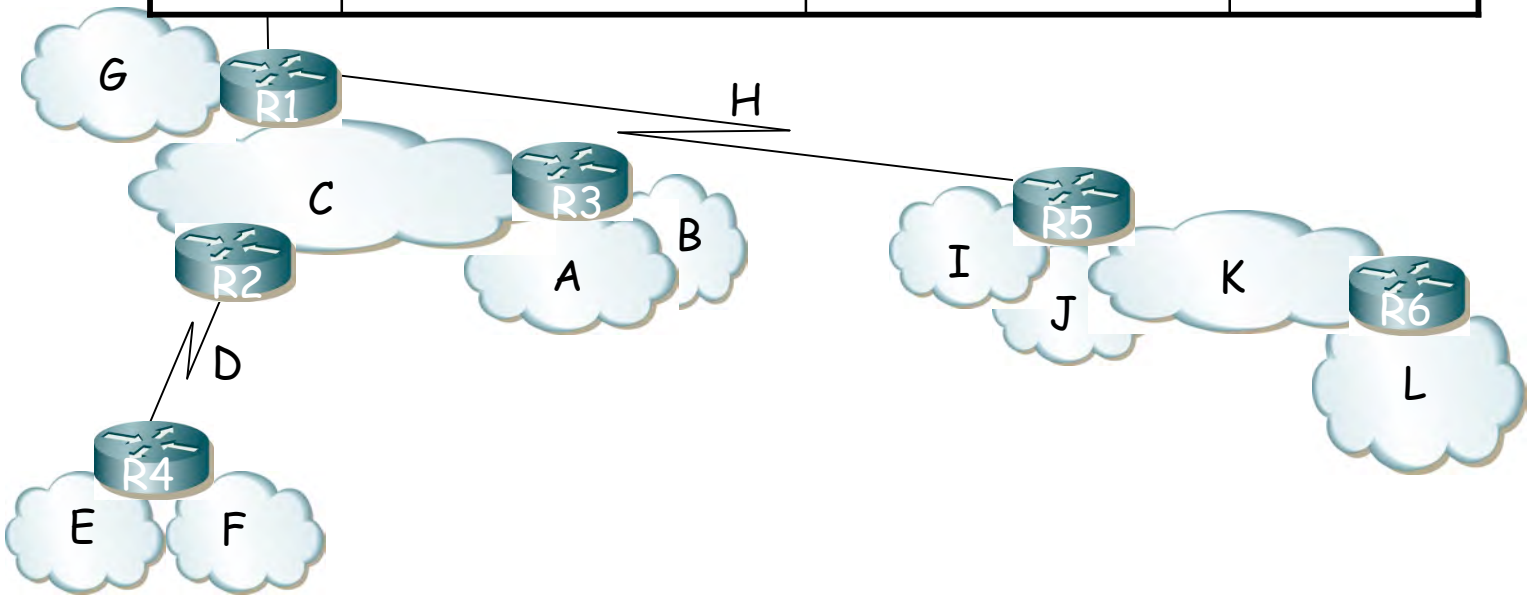


Ejemplo (4)

Mejora 2

Tabla de rutas de R4:

Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
Red	102.168.3.0 /24	IPR2ifRedD	ifR4RedD

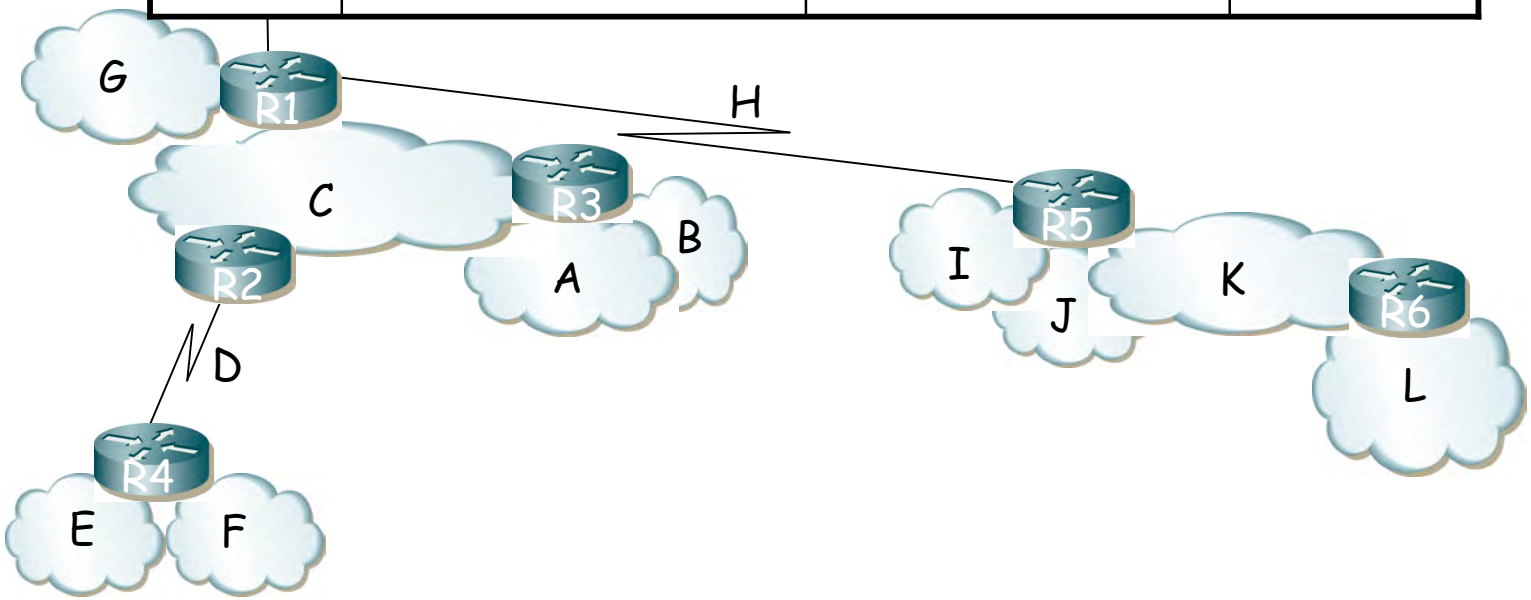


Ejemplo (4)

Mejora 3

Tabla de rutas de R4:

Destino		Next-hop	Interfaz
Red D	192.168.3.96 /30	(dir.connected)	ifR4RedD
Red E	192.168.3.64 /28	(dir.connected)	ifR4RedE
Red F	192.168.3.80 /28	(dir.connected)	ifR4RedF
(def.)	0.0.0.0 /0	IPR2ifRedD	ifR4RedD



Un par de detalles sobre los *resúmenes*

Ventajas

- Menos memoria
- Menos CPU
- Menos BW en updates
- Esconde inestabilidades (…)

Desventajas

- Menor precisión
- Puede crear asimetrías (…)